Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXI] OCTOBER 1933 [No. 10

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MODIFIED DRY COMBUSTION METHOD FOR THE DETERMINATION OF ORGANIC CARBON IN SOILS.

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The estimation of organic matter in the course of a soil study is of fundamental importance since this soil component affects markedly the physical, chemical and biological properties of the soil. Just like clay, it possesses many of the properties of colloids: it modifies greatly the readiness with which mineral plant food is rendered available to the crop and it is the medium in which the micro-organisms in the soil live and perform their functions.

The loss-on-ignition method was probably the first to be employed for the estimation of soil organic matter. But this gives very unreliable results especially when the soil– contains clay and carbonates. As a striking example could be mentioned the analysis of a sample of black soil from Hagari. This gives a loss on ignition (exclusive of moisture lost at 100°) of about 7%. Out of this there is only 0·9% of organic matter, the rest of the loss being due to carbonates and combined water. Methods employing sodium hydroxide, ammonia or hydrogen peroxide are probably useful for the estimation of particular parts of organic matter present in the soil and not for the whole of it. (1)

The majority of the methods now commonly employed are based on the determination of organic carbon by a wet or dry combustion method and then calculating the organic matter by using a conventional factor, 1·724. Allowance is made for the presence of carbonates which are estimated separately. Among wet combustion methods, the rapid volumetric procedure of—Schollenberger (2) and its modifications give at best only a rough idea depending upon the nature of the soil components and upon the state of oxidation of the organic matter. Soil organic matter is, extremely complex and exists in different states of oxidation. The presence of reducing and oxidising—substances greatly modify the validity of the results. Robinson's new method (3) using the Kjeldahl procedure suffers from the same drawbacks. Even in the simplest cases of sugars having the formula $C(H_2O)_n$, he did not get complete recovery. With such varied classes of substances as acids, fats, waxes, proteins and other nitrogen compounds the equation $C + 2H_2SO_4 = CO_2 + 2H_2O + 2SO_2$, does not find a uniformly approximate application. Under the circumstances only the direct absorption and weighing of the carbon dioxide evolved may be expected to give reliable results for the organic carbon content. Even here, wet methods using solutions of chromic acid or permanganate, give low results evidently due to incomplete oxidation, and these are only slightly less laborious than the dry combustion method which is universally recognised as the standard. Owing to the wide applicability of this dry combustion method, modifications to make it more rapid and free from any possible source of error will be very valuable and this has been the aim of the work described in this paper.

Before embarking on the estimation of organic carbon in soils, it was proposed first to work out a modification using pure organic substances of various types whose compositions have been established beyond doubt. The chief difficulties in the Liebig's combustion method are (i) slow and sometimes incomplete combustion of some complex refractory bodies, and (ii) the errors introduced by the presence of nitrogen, halogen and sulphur in the substances analysed. The first has been greatly minimised by the use of oxygen for the combustion instead of air and by using platinum boats instead of porcelain ones. Nitrogenous compounds give rise to oxides of nitrogen which get absorbed along with carbon dioxide and thus high values are obtained. Fresh, reduced copper coil placed at the exit end of the combustion tube, removes this error by reducing the oxides to nitrogen, but its use is cumbersome and tedious. Halogen compounds give rise to halogens which have been attempted to be trapped by using a U tube of potassium ferrocyanide or a similiar reagent, but the best procedure seems to be the use of red hot silver gauze or wool. Oxides of sulphur from the sulphur compounds have been attempted to be removed by using sodium chromate solution or pumice soaked in

concentrated sulphuric acid. But these are not found to be effective. The most perfect solution of all these difficulties is that of Pregl (4) in what is known as the Universal filling of the combustion tube for micro-estimations. He uses a mixture of copper oxide wire and lead chromate (hempseed size) or copper oxide impregnated with the chromate for filling the combustiou tube in the place of the usual copper oxide. The lead chromate at red heat retains all oxides of sulphur effectively. Short lengths of silver wool kept at red heat remove the halogens and the nitrous fumes are absorbed by pure lead peroxide kept at the boiling point of decalene. This has been adapted for macro—combustions also by Davies (5). In this procedure lead peroxide is the chief source of trouble. It requires to be specially pure and made into a particular state of subdivision. Variations from the optimum conditions of temperature means failure of analysis. On a macro scale it is rather cumbersome to use and the constant temperature arrangement is not easily fitted up. The chief characteristics of the modification adopted in this paper and found suitable for soils in ordinary laboratories are as below :—

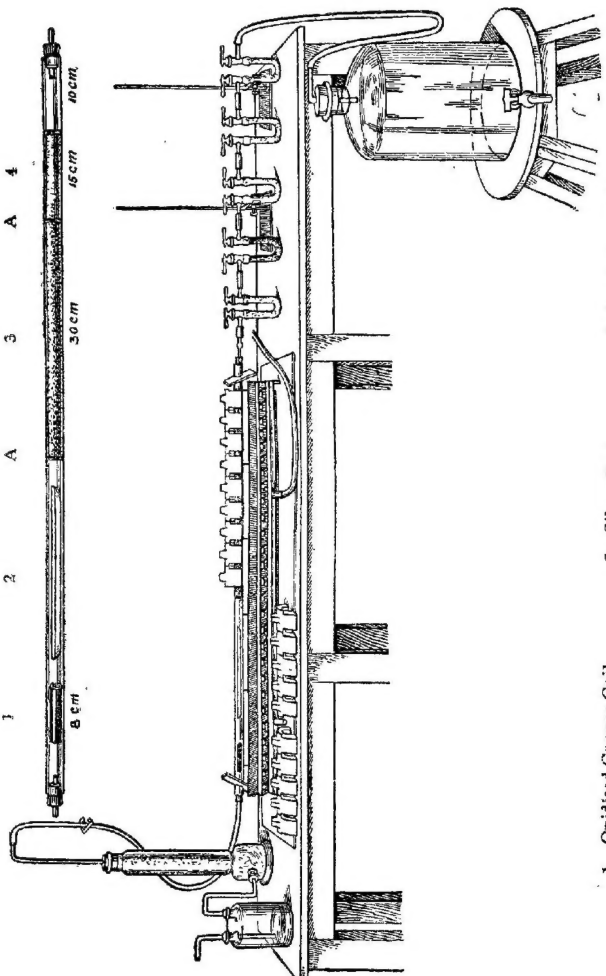
(i) the substance is mixed up with powered copper oxide and burnt at red heat in a current of air. Under the circumstances there is rapid and complete oxidation of carbon ; oxygen is not necessary for the combustion.

(ii) a mixture of well ignited wire form copper oxide and lead chromate (hempseed size) is employed for filling the tube. Oxides of sulphur are thus retained.

(iii) a length of about 15 c. m. of closely packed fine silver wire or wool at red heat serves to remove all halogens.

(iv) instead of lead peroxide and the decalene bath, a U tube containing pumice soaked in concentrated sulphuric acid has been found to be quite effective in retaining nitrous fumes. Probably the combined action of silver and sulphuric acid gives the arrangement its merit.

Materials for filling the combustion tube. A good hard glass combustion tube about 1 metre in length and 8 to 10 m. m. in diameter is chosen, the ends are softened in a flame or smoothened with a grinding stone or file and finally cleaned and dried. Pure precipitated lead chromate is moistened with water formed into a thin slab on a glass plate and cut into small pieces. This is first dried in the steam oven, transferred to a nickel basin and ignited over a bunsen burner for about one hour. At this stage the substance is in the form of irregular pieces of hempseed size. Wire form copper oxide also is ignited for half an hour in a nickel crucible over a bunsen burner. The silver



1. Oxidised Copper Coil. 2 Silver Boat. A, A. Asbestos Plugs.
3. Copper Oxide Lead Chromate Mixture. 4. Silver Wire.

wire was the thinnest that could be made out of pure silver by a local silver smith. Asbestos used for the filling was pure gooch asbestos which was well ignited in a platinum basin over a strong bunsen flame.

Filling the combustion tube. A, A are asbestos plugs about 1 c. m. in thickness. About 10 c. m. length is left empty at the exit end. The silver wire is cut into small lengths and packed closely into the tube. Used up samples are ignited in a current of hydrogen and then they are fit for use again. When the copper oxide and lead chromate are prepared as stated above, they do not require igniting in the combustion tube very long. There is then ample space in the tube for introducing the boat and an oxidised copper coil 8 c. m in length. The boat was made locally out of pure silver. It just went into the tube easily and it was about 1 m. m. in thickness. The length was between 6 and 8 inches to suit circumstances so that it easily took in the copper oxide soil mixture. It is not seriously affected during the combustion. The inside alone gets a little brown after considerable use.

The purifying and absorption trains. Before entering the combustion tube the air that is aspirated bubbles through 50 per cent. potassium hydroxide kept in a Wolfe's bottle, and subsequently through a big soda lime tower. The absorption train consists of the following:—

(i) *U tube containing coarse granules of calcium chloride for removing water*:—It was found essential to provide this with a bulb at the inlet so as to condense most of the water produced. With some clayey soils containing large quantity of water of chemical combination this was found to prolong the life of the calcium chloride considerably. Since calcium chloride is likely to contain some lime it was first saturated with carbon dioxide by connecting the U tube to a Kipp's apparatus provided with a gas washing bottle containing concentrated sulphuric acid. After passing the gas for a few minutes the outlet tap was closed and the tube left with the other end connected with the Kipp for 12 hours. The U tube was then disconnected and about 200 c. c. of air passed through in about 10 minutes so that the excess of carbon dioxide was completely removed.

(ii) *U tube containing pumice (hempseed size) soaked in concentrated sulphuric acid*:—This should contain some excess of sulphuric acid so that a little of it collects at the bottom bend and serves as a bubble counter. Since the gases coming in here are dry, the acid does not get diluted and hence is more effective in absorbing nitrous fumes.

(iii) *Two soda lime U tubes for absorbing carbon-di-oxide*:—These tubes have a few centimeteres of calcium chloride at the exit ends so as to prevent the escape of moisture from the moist soda lime. For good absorption it is essential to ensure that the soda lime is sufficiently moistened. For this purpose the substance is spread on a large

piece of paper, and water sprayed from a wash bottle provided with a narrow jet. Too much of water rendering the granules sticky should be avoided. The first U tube is usually refilled when the second shows an increase of over 1 m. g. in weight during an estimation. The quantity of moisture in the soda lime limits the number of estimations for which it could be used. With one sample containing sufficient moisture the first tube was effective for more than 20 estimations and the second did not show any appreciable increase during each estimation. Whereas in another case with less moisture it could not be used for more than 6 estimations. During the combustion it is essential to wrap the soda lime absorption tubes with wet cotton, as otherwise considerable heat is generated and the soda lime loses moisture and its absorptive power is lessened.

(iv) *A U tube containing soda lime in one limb and calcium chloride in the other to serve as a guard tube. Blank test*:—Since the wire from copper oxide and lead chromate had been ignited prior to filling, the tube required only a preliminary heating of about 2 hours at dull red hot during which time about 1500 c. c. of air was aspirated. It was then ready for a combustion. Commercial copper oxide powder gives a fairly high blank even after ignition in a nickel crucible for one hour over a strong bunsen flame. This could be eliminated by keeping it at red heat in a hard glass tube for one hour and aspirating 700 c. c. of air through. Large quantities (100—150 grams) could be treated at one time and stored up for use. A blank using this copper oxide gave practically no increase in the weight of the soda lime absorption tubes.

Analysis of pure organic substances:—*Carrying out a combustion.* The combustion tube which has been filled and ignited as above is now connected to the calcium chloride and sulphuric acid U tubes and the front part containing the copper oxide lead chromate mixture raised to dull red heat. Meanwhile the substance (about 0·1 gram) is weighed into a small clean porcelain basin mixed with 10 grams of specially ignited copper oxide and transferred to the silver boat. The basin is washed twice with small quantities of copper oxide and the washings added to the boat. The weighed soda lime U tubes and the guard tube are now connected in the front and after all the taps have been opened, the boat and the oxidised copper guaze are introduced into the combustion tube and the rubber stopper is pushed in tight. The aspirator is then connected and a very gentle stream of air is aspirated by adjusting the air inlet in the purifying train. The oxidised copper coil is first raised to dull red heat and next the boat itself heated very slowly so as to avoid too rapid a combustion. About half an hour is an optimum time for the complete combustion. When the gas evolution has slackened considerably as judged from the bubbling in the sulphuric acid tube the air inlet is opened wider and about 350 c. c. of air aspirated. At the beginning the rate is kept slow, but later on

it could be increased so that 20 c. c. is aspirated in a minute. This does not take more than one half hour so that the combustion and absorption takes just less than one hour.

Before starting another combustion the burners in the back part of the furnace containing the boat and copper gauze are turned out, the tiles removed and this portion allowed to cool as the absorption tubes are being weighed and a fresh sample got ready. It was found advisable to turn out 1 or 2 burners under the copper oxide lead chromate mixture also in order to avoid cracking of the tube when the cold boat was introduced. This precaution is specially necessary in the case of soils containing high percentage of chemically combined water. The side arms of the U tubes are cleaned inside with a little cotton the stoppers opened for a moment closed again and then weighed.

The whole analysis takes less than 1½ hours and 5 to 6 estimations could be done in a day. The method was tested by using a number of pure organic substances belonging to typical groups. Even very refractory bodies burnt very smoothly and rapidly. Amongst nitrogen compounds, the aromatic nitro-compounds have been shown by Pregl to offer the crucial test of the efficiency of a method since they give rise to large quantities of nitrous fumes. With this method these have given quite correct values for carbon. The highly resistant sulphur compound, sulphonal offered no difficulty. The results of several repetitions with each compound were found usually to be about 0·2 to 0·4 per cent high.

Sample analytical results.

	Found.	Required.
	%	%
Cane sugar	42·3,42·1	42·1
Cholesterol	84·2,83·8	83·8
Acetanilide	71·3,71·2	71·1
Strychnine	75·8,75·4	75·5
Uric acid	36·1,35·9,35·7	35·7
Metadinitro benzene	43·1,42·9,43·0	42·8
Sulphonal	36·9,36·7,36·9	36·8
Bromoethylphthalimide	47·6,47·4	47·3

It may be suggested that for a macro method for C and H the same apparatus could be used with only this modification that instead of the admixture of the substance with fine copper oxide it has to be burnt in a current oxygen.

For the determination of organic carbon in soils the amount of the sample to be taken for analysis will depend upon the nature of the

specimen. Usually enough soil is taken so as to yield about 0. 1 g. of carbon dioxide. A sample passing a—100 mesh sieve is found to be convenient as thereby errors due to sampling of small quantities could be minimised. Otherwise the decomposition is equally good even with 1 m. m. mesh samples. It is mixed with 10 grams of the specially ignited copper oxide and the combustion carried out as above.

The chief difference between the analyses of pure substances and of soils lies in the length of time for which the heating is to be done. This is due to the presence of carbonates in the soils in more or less quantities. They may require longer heating and greater volume of air to be aspirated in order to complete the decomposition. Since calcium carbonate is the one most common in soils and probably the most difficult to decompose, experiments were made to find out the conditions of complete decomposition of calcium carbonate when mixed with copper oxide and ignited in the combustion tube at red heat. The progress of the decomposition was followed by stopping the aspiration of air and disconnecting the soda lime tubes at different intervals and weighing them. It was thus found that by keeping at red heat for about 45 minutes and passing 700 c. c. of air only 75% of the carbonate underwent decomposition, whereas after just more than one hour and passing 1000 c. c. of air though, the decomposition was complete.

On the other hand sodium carbonate decomposed to about 20% only under the same conditions within 1½ hours. Further decomposition was exceedingly slow. Hence this combustion method may not give quite correct results with soils which contain sodium carbonate, since the correction for the presence of carbonate in evaluating the organic carbon cannot be found out exactly.

It should be mentioned here that with all the soils mentioned below it was found that the oxidation of the organic matter and the decomposition of the carbonates could be completed by carrying out the cumbustion within one hour which involves keeping the boat at red heat for about 30 minutes and aspirating 350 c. c. of air only. The actual burning of the organic matter takes about 30 minutes and the carrrying over of carbon dioxide into the soda lime tubes takes 20—30 minutes. The rapidity of the decomposition of soil carbonates may probably be due to their existence as a mixture of various metallic carbonates. This considerably shortened the time of analysis so that about 5 to 6 analysis could be done in day.

The following soils from typical localities in South India were analysed for organic carbon. The results indicate values obtained after allowing for the carbonates which are here expressed as Calcium carbonate.

Serial Number.	Soil description.	Carbon. %	$CaCO_3$ %	Remarks.
	Dryland Soils.			
1	Coimbatore, Central Farm. (New Permanent Manurials) Cattle manure plots.	0·74, 0·74	2·27	Pale red soil.
2	Do. No manure plots.	0·59, 0·59	2·75	,,
3	Hagari (Bellary district) Soil Moisture Plots. 1st foot	0·53, 0·52	5·95	Heavy black soil.
	,, 2nd ,,	0·52, 0·54	6·55	,,
	,, 3rd ,,	0·50, 0·50	6·84	,,
	,, 4th ,,	0·52, 0·52	7·34	,,
	,, 5th ,,	0·59, 0·58	8·27	,,
	,, 6th ,,	0·49, 0·46	8·59	,,
4	Koilkuntla (Kurnool district).	0·53, 0·51	3·32	Black soil.
5	Palakkuppam.	0·35, 0·35	0·39	Red loamy soil.
	Wet Land Paddy Soils.			
6	Coimbatore, Central Farm. Green manure plot.	0·74, 0·74	0·41	Puddled with green manure. Heavy soil.
7	Vedapatty, Paddy Breeding Station, Coimbatore.	0·73, 0·73	0·93	,,
	Estate Soils.			
8	Upper Parlai Estate, Valparai.	2·66, 2·69	0·32	Pale red soil.
9	Arnakal Estate.	2·00, 1·96	0·14	,,

This work was done in the Chemistry Section of the Agricultural Research Institute, Coimbatore and the author expresses his thanks to the Govt. Agricultural Chemist for facilities offered.

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(1) Soil Science, 30. 97.
(2) ,, 24, 65.
,, 31, 483.
,, 29, 239.
(3) Journal of Agricultural Science. 19, 315.
(4) Pregl. Quantitative Organic Micro-analysis. (translated by Fyleman).
(5) Journal of the Chemical Society. 1927, 3161.

SUGARCANE INSECTS AND PROBLEMS CONNECTED WITH THEM IN SOUTH INDIA*.

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Introduction. In the Madras Presidency, sugarcane is cultivated in all the important agricultural tracts, and at present, the area under this crop occupies somewhere about 126,000 acres.

The latest available crop statistics show the following distribution of cane area in the Presidency.—N. Circars 48,750 acres; Central districts 44.500; Carnatic including Nellore, Chingleput and S. Areot 12,850; the Ceded Districts 11,700; the Southern districts 3,800; West Coast and Hills 3,620. For the whole of India the area under cane during 1931—32 has been noted to be 2,886,000 acres; over 50% of the sugar products is from the U. P

* Note prepared as a member of the Committee for preparing a Sugarcane Pests Research Scheme. which met at Simla on 7th August 1933.

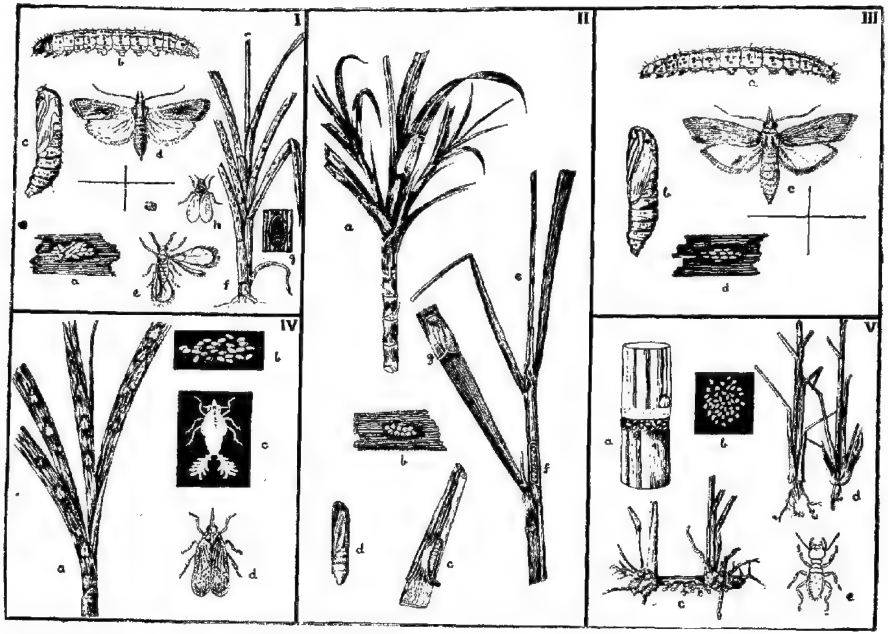
Of this total area, over two thirds of the acreage is confined to the Northern Circars including the Ganjam, Vizagapatam, Godaveri and Kistna Districts and the central tract including the districts of Chittoor, North Arcot, Salem, Coimbatore and Trichinopoly. As a result of the recent inducements to develop the Sugar industry in the shape of tariff protection, and the opening up of several irrigation projects in the different provinces, there are indications to show that the existing area under sugarcane is sure to increase considerably during the coming years, and that the problems connected with this industry are sure to assume more and more prominence in the near future. And of the various such problems, those connected with the animal and vegetable parasites which levy their toll on this important crop, are no less important. According to Fletcher, 'the damage done by cane borers alone is roughly estimated at 30 million rupees a year. Though this estimate may not be quite accurate, it gives us some idea of the loss by pest infestation, and reminds us of the fact that this aspect of the sugar industry is well worth a thorough investigation at the hands of scientific men and sugarcane cultivators. This note is prepared with the idea of presenting in a brief manner the present position regarding sugarcane insects in S. India, their comparative economic importance, and the chief problems connected with them which the sugar planter has to deal with. As far as possible, scientific details and technicalities have been avoided.

Sugarcane pests in S. India. Though the area under cane in S. India is far less than in some of the Northern Provinces and the damage caused to the sugarcane crop by insect and other pests is not so pronounced as in the case of crops like paddy or cotton; sugarcane often suffers at the hands of such pests and diseases, and appreciable damage and loss are caused thereby. To the sugarcane farmer who is anxious to grow a good crop and reap a decent harvest of vigorous, vermin- free and healthy canes, a knowledge of the nature and habits of the more important pests, and some familiarity with the possible control measures against them, will always be of very great help. And now that the area under sugarcane is increasing rapidly, information in this direction might be of great use and very much appreciated. With regard to cane insects with which only this note deals, though a dozen or more insects have been found associated with the sugarcane plant in the different tracts of this province*, not more than three or four could at present be put down as forms which might be considered as serious major pests ; the others are ordinarily of minor importance and become serious only very rarely, causing sporadic local infestations.

The Major Pests. The most important pests of sugarcane in S. India which may be ranked as the foremost and which generally

* *Vide* author's bulletin on List of S. Indian crop pests—Madras Department Bulletin No. 27 (1932).

SUGARCANE INSECTS OF S. INDIA



I. (a) Eggmass oi *Argyria sticticraspis*.
(b) Larva of Do.
(c) Pupa of Do.
(d) Moth of Do.
(e) *Trichogramma minutum*, R. (egg parasite).
(f) Cane showing central shoot drying and leaves infested with mealy wing.
(g) Puparium of mealy wing.
(h) Adult mealy wing.

II. (a) Cane shoot showing attack by white top shoot borer with moth on it.
(b) Egg group of white borer (*Scirphophaga*).
(c) Pupa of Do in stem.
(d) Pupa enlarged.
(e) Plant showing attack by pink borer (*Sesamia inferens*) with larva in stem.
(f) Moth on plant.

III. (a) Larva of *Diatroea venosata*.
(b) Pupa of Do.
(c) Moth of Do.
(d) Eggs of Do.

IV. (a) Plants showing *Pyrilla* infestation.
(b) Eggs of Do.
(c) Nymphs of Do.
(d) Adult bug.

V. (a) Cane showing mealy bugs on node.
(b) Young larvae of mealy bugs.
(c) & (d) Termite attack on setts and plants.
(e) Termite enlarged.

cause appreciable damage are the Moth borers and Termites, and it is only in connection with these two sets of pests that the Entomologist very commonly receives complaints and reports. As next in importance to them, we may include the two or three sucking insects which occasionally appear as pests, *viz.*, the cane mealy bug, the mealy wing and the leaf hopper.

The Moth Borers— Of the insects associated with sugarcane, the borers of one or other species are very ancient and well-known pests of this crop, being found in almost all the sugarcane areas of the world; and unlike other insects which have often a local or restricted distribution, the moth borers are very cosmopolitan and practically perennial pests of the crop: the only point to be noted is, that the species in different countries are not the same. The species chiefly concerned in the West Indies, Lousiana, Mexico and British Guiana is *Diatroea saccharalis*, F. Of the three or four species of sugarcane moth borers found in S. India, the only important one is the insect known by the name *Argyria sticticraspis*, H. Though this insect has been known for a very long time it was not until very recently that the correct identification of this borer was obtained. For many years past this insect was confused with one or two similar borers which very closely resembled this species and had practically the same life habits; and all these passed under the same name *Chilo simplex*, B, since all these allied insects were found breeding on sugarcane, sorghum, maize and allied plants. Recent work on this insect and other allied borers, especially done in Pusa†, has clarified this confusion to a certain extent, and as far as we know, our most important moth borer pest of sugarcane is now definitely identified as *Argyria sticticraspis*, H. Though found on allied plants it is particularly partial to sugarcane and attacks the latter usually during the very early stages, causing '*dead hearts*' in young plants; it does not infest grown up canes so much as those in the younger stages. This insect may be considered as the most important of sugarcane pests in the province. Another borer which is said to attack the upper portwind of cane in Java* (*Diatroea venosata*, W) and which has practically the same habits as *Argyria* is not so common as the latter and is generally found attacking grown up canes and causing comparatively much less damage. The white top shoot borer (*Scirpophaga nivella* F), is another very easily distinguishable, cream-white moth with quite different habits and found occasionally in Circars, S. Arcot and Coimbatore. The caterpillar, unlike as in other forms, burrows down into the top shoots of the grown up cane, kills the central shoot and often causes the peculiar bunchy side shoots which indicate the presence of the pest in the field. Though this

† *Vide* papers in the Reports of 3rd and 4th Entomological Meetings—Pusa—by Fletcher & Ghosh.

* [Hart] Ren Apptry June 1933 p. 274.

insect is mainly confined to sugarcane as its food plant and does not breed on sorghum and other crops like the two previously mentioned forms, it has rarely assumed the status of a serious pest so far. Another borer worth noting in connection with cane, is what is known as the wheat stem borer in N. India and the *ragi* Pink borer (*Sesamia inferens*, D) in S. India. In S. India it is a specific pest of *ragi* and maize and is found breeding on sugarcane only occasionally; the caterpillar has a pinkish color and the moth is a member of a different family from the other borers noted above, and does not strictly come under the category of what are considered as typical moth borers.

Termites. Next to the moth borers we may place the termites as cane pests of some real importance. Two species have so far been found connected with injury to cane, *viz.*, *Odontotermes obesus*, R., and *Eutermes heimi*, W. The great bulk of the damage caused to sugarcane by white ants is to planted underground setts; these are entirely eaten up hollow and the germinating buds completely destroyed in many cases. This happens especially in white-ant-infested and comparatively dry areas and this kind of damage is due chiefly to the work of *O. obesus*, R., a very widely distributed termite in S. India. Serious and whole-sale losses of seedlings are often reported from different parts, especially from newly planted and termite-infested tracts. The other species (*E. Heimi*, W) is a leaf eater and swarms of these appear late in the evening on young seedlings, cut out pieces of the leaf blades and strip the leaves outright, skeletonising the few leaves of seedling canes. This kind of damage is often particularly bad in the nurseries raised in the Sugarcane-breeding Station at Coimbatore where very young seedlings are raised from seeds.

Minor Pests. Among the insects of secondary importance as cane pests in S. India, we may include in the order of their importance, the *mealy bugs*, the *mealy wings* and the *cane leaf hopper*; all these are sucking insects and are not internal feeders like borers. The damage done by mealy bugs consists in colonies of the small insect in different stages attaching themselves to the nodes of the growing cane, sucking up the juice and allowing the plant to lose its vigour and in bad cases to fade away. Generally these are small pale reddish creatures covered with a white mealy bloom and found partially protected by the drying up leaf sheaths at the nodes, and this protection hides them from exposure. Often, these creatures are carried in setts used for planting and get distributed from place to place. Of the species known from S. India, the commonest appears to be *Ripersia sacchari*, *Gr.* (Fig.) though the species *Aclerda japonica*, N., is occasionally noted. The mealy wings and the leaf hopper are found on the foliage, where they cause the same kind of harm as the mealy bug, by sucking up plant juice, thus draining away the nutrition from the growing plants and causing them to fade. The mealy wings found, include two species

Alcurolobus barodensis, M., and *Neomaskellia bergii*, S. though the former is the commonest (see Fig.) and has a very wide distribution all over India; the bluish-black puparia of this insect are often found in numbers on the foliage of grown up canes in certain tracts, and this often gives a blighted appearance to the leaves. The cane leaf hopper (*Pyrilla perpusilla*, W) is a very active straw colored bug, with the head prominently drawn forwards as a sort of rostrum (Fig.). In certain seasons and tracts, the insect increases in some numbers and colonies of the same in its various stages are found causing appreciable damage to the tender foliage of sugarcane plants. This insect may to some extent, be compared with the frog hopper pest of Trinidad and the cane leaf hopper of Hawaii, though our insect has not as yet assumed the role of either of these two serious exotic pests. Since preparing this note, the writer has received two reports of serious damage by this insect—one from Salem and one from the Nellikuppam Distilleries sugar farms. The pest in the latter case was found rather serious and organised control measures in the shape of eggmass collecting, bagging and light traps were suggested. Masses of eggs, and colonies of the hopping nymphs may be found in badly infested fields and generally, the eggs are found badly parasitised.

The other insects associated with sugarcane in S. India include one or two leaf caterpillars,[1] a leaf eating beetle,[2] a species of thrips,[3] and a species of root aphid.[4] The leaf caterpillars and the beetles have never been noted as serious so far; the thrips, which attack the tender foliage and cause the peculiar rolling and wriggling of the leaf tips, occasionally cause the leaf tips to dry, but is very rarely serious. The same can be said of the root lice also, which now and then damage the roots in some areas. The rice grasshopper[5] though known to be a pest of cane in parts of N. India, is not generally found to be serious in this province; it might, as in parts of Ganjam, do some occasional damage to cane growing in the midst of paddy on which the insect is a very serious pest.

Before closing the remarks on cane insects, mention has to be made of the notorious *Aphis maidis*, F., which is said to be responsible, as the vector, for the mosaic disease of cane which is not absent in S. India. This insect is commonly found on cholam and as far as the writer is aware, it has not been found in any notable numbers on cane in S. India

Problems Connected with Sugarcane Insects. The entomological problems connected with sugarcane in S. India are mainly, if not solely, those relating to the investigation and control of the *moth borers*

1. *Telicota augias*, L. (a butterfly)
2. *Phidodonta modesta*, W. (a small spiny black beetle).
3. *Bregmatothrips ramakrishnae*, B.
4. *Tetraneura ulmi*, V. G.
5. *Hieroglyphus banian*, F.

and the *Termites*. Recent studies carried out by the Entomological staff of the Madras Agricultural Department especially in the N. Circars, have shown more than anything else that the only borer with which we in S. India have to seriously contend against is the species *Argyria sticticraspis*, H. This borer is present in all the important cane tracts like the Northern Circars, Coimbatore, Ceded Districts, S Arcot, etc. The extent of damage done by this borer to the primary shoots often ranges from 10 to 30 per cent. or more in certain years. The intensity or otherwise of the infestation often varies with seasonal changes taking place in the area in addition to the different varieties of cane grown. The infestation generally takes place from the period of germination up to a period of 5 weeks. and it is during this period that dead-hearts appear in the infested fields. Though the results of work so far done show in many cases a final difference of 10 per cent. in favour of borer free canes, the writer is of opinion that the actual loss finally caused to the cultivator by this insect does not very much depend upon the percentage or degree of infestation of the primary shoots. For, in some cases, the final out-turn from badly infested fields have been found to be much more than that from fields which were comparatively free or very mildly infested in the early stages. There is one important factor which has to be taken into account in investigating the subject of borer attacks in the early stages of cane, and that is, the tillering properties of canes and the consequent power they often possess of picking up vigour during their growth for 8 or 10 months after initial borer infestation, and regaining the standard output. Though some substantial work has been done in estimating the loss caused by the borer and data have been collected, it is believed that a good deal of further work has to be carried out to ascertain definitely the actual loss caused by moth borer attack to different canes and in important cane growing tracts. In this connection it will not be out of place to quote the pertinent remarks* of Dr. Myers on this question of determining the loss by borer attack.

"What we most clearly lack, however, is a standard method of estimating infestation and from that, determining damage so that figures from different fields and different countries can be legitimately and conveniently compared so that we may, in some manner keep our thumb on the pulse of moth borer destruction, and really observe whether our own or our neighbours' attempts at control, are having any effect and if so just how much ".

We have therefore to devise some standardised methods of estimating borer injury to cane to get at the real loss caused. A good deal of ecological study has also to be done in connection with the moth borers in the relation to cane varieties, seasonal changes, alternate host plants, temperature, humidity changes in cultural practices and other factors including the nature and activities of natural enemies.

* International Sugar Journal—October 1932. p. 377.

Regarding trials of control methods a good deal might be done in the way of prophylactic measures. Of these, the selection of healthy setts for seed is a very important one; for unless this is very carefully done we will be planting the borers also when we plant the seed cane! Trials with insecticidal methods of killing with arsenicals, fluosilicates etc., have not shown any encouraging results; nor has the time arrived to suggest such measures to Indian ryots. Niether the adoption of trash traps nor the method of egg picking has been found of any avail as effective or practical control propositions. There is a good field, open of course to cane breeders, to help the ryot by breeding and evolving out borer-resistant varieties and such work is being carried in all the important cane growing areas of the world. Coming to the method of biological control, it is known that the borer is subject to the attacks of some hymenopterous parasites, some of which are present in most areas*. However, it is not yet definitely known whether their work of checking the borer has been sufficiently evident and satisfactory. Speaking especially of the biological method of control with the egg parasite *Trichogramma minutum*, Ry. (Fig.) now being adopted in various parts of the world, though it has been boomed by some in different countries as a remarkable success, there is a concensus of opinion among the more responsible men concerned in this work that this method of control has not as yet been found very convincing. This may be gathered from an important resolution† adopted on biological control by the meeting of several eminent entomologists at the Fourth Congress of the International Society of Sugarcane Technologists held in March 1932 at San Juan in Porto Rico. The resolution was to this effect: "In view of the great publicity which has been given to costly attempts in various parts of the world to control the cane moth borer by mass breeding and liberation of *Trichogramma* egg parasite, and in view of the fact that entomologists who have been engaged in this work on a comprehensive scale are in wide disagreement as to the practical results, if any, of this method, this Congress, after examination of all published evidence cannot endorse the plan, until answerable statistical evidence of its efficacy is forthcoming." This weighty statement does not, of course, mean that further investigations should not be continued in this line, but only goes to show that the work with parasites is not after all as easy and smooth sailing as some of us believe; in the words of Dr. Howard "one's outlook becomes more or less confused when one considers the complications" connected with such work. Coming to the direct methods of control, cutting out the dead hearts in time, to check the multiplication of the borer at the very early stages might deserve a

* In S. India we have one or more braconids of the genera *Stenobracon* and *Apanteles* and of the I chneumonids *Xanthopimpla* and among Scelconids a *Phanurus* and of the chalcids we have the now well-known and famous wasp *T. minutum R.*

† Inter sugar, gl. October 1932 p. 379.

word or two. The borer which attacks the cane during the younger stages can be controlled to some extent by prompt destruction of the shoots with dead hearts; but in most cases the cultivator is either indifferent or the operation is done very unsatisfactorily by only pulling out the dead shoot and leaving the borer in tact! In the N. Circars where there is the method of wrapping and supporting the growing canes, some of the side shoots are removed as a cultural practice during the operation; if in this process the farmer takes some care to specially cut out the infested shoots with the borer *in situ* and destroy them, a certain amount of control could also be effected. One unfortunate fact in connection with the cane borers is that, in most of these cane areas, there is sugarcane growing at some stage or other throughout the year for the pest to pass over from season to season and help its perennial multiplication. As suggested above, we have to carry out first and foremost an intensive study of the bionomics of the different moth borers to gauge the actual loss caused by each and then experiment with different control measures before we are in a position to suggest any methods of an economic and practical nature to the ryot.

The Termite problem is not half so important or serious as that of the borers which are often described as "the hardy annuals if not perennials among the pests of sugarcane". Proper selection of termite free area for cultivation, sufficient culture of the land, proper irrigation and other prophylactic measures like selection of healthy seeds and treating the setts with deterrent substances would certainly keep away termites, and even if they occur there are methods which can check their damage in the shape of soil fumigation by mixing the irrigation water with tar water or Crude oil emulsion. A radical method for termite in any area is to locate the termite nests in the vicinity, dig out the nests and destroy the queens, and in the case of the leaf feeding termite in cane nurseries the plants may be sprayed with a dilute solution of some deterrent like Crude oil emulsion. In this work, of course, proper identification and habits of the termites concerned is an essential preliminary since errors are very often made in mistaking one species for the other and applying the wrong treatment.

Regarding the other insects—only the Mealy bugs, Mealy wings and the Leaf hopper occasionally call for attention though they have been noted rarely as serious pests in the province. As in the termites some preliminary work has to be done in identifying correctly the mealy bugs and mealy wings responsible for the damage on cane in the different tracts before adopting the appropriate measures suited to each form. For mealy bugs, the selection of clean setts is of very great importancce. Some of the other measures suggested by Hall*

* The outbreak of *Pseudococcus sacchari*. C., on sugarcane in Egypt by W. J. Hall.—Teachnical and Scientific bulletion, Cairo, 1922. There are some records of the existence of this bug on cane in some parts of India but this has to be definitely ascertained.

for the Egyptian mealy bug may also be tried. The mealy wings and the leaf hopper which are leaf pests, occasionally appear to do some harm in certain seasons but prompt mechanical methods may be found to check these pests to a great extent. Both these kinds of insects are also subject to the attacks of some effective parasites.

Suggestions For Future Work. In the opinion of the writer, the following appear to be the more important items in research work connected with sugarcane insects in India.

(i) A complete survey of the insect fauna of the sugarcane plant in different parts of India and Burma; this should include the geographical distribution, original habitat, different food plants, natural enemies, life history notes and the economic importance of each insect. This would give us the correct identity and the distribution of each of the different borers etc.

(ii) A detailed study of the behaviour of the more important cane pests of each tract with special reference to such factors as the time of planting, manurial response, spacing, tillering with reference to varieties, etc.

(iii) The exact nature and the correct estimate of the damage caused by each pest both in relation to different localities and varieties of cane.

In Madras, such special studies are to be devoted to the *borers*, *termites*, *mealy bugs* and the *leaf hopper*.

(iv) The study of sugarcane mosaic in relation to insects as vectors.

(v) Trial of remedial measures including Prophylactic, Cultural, Mechanical, Insecticidal and Biological methods. Special attention may be devoted to the study of natural enemies and methods of biological control according to modern technique. These may be carried out in ways which will suit the different local and economic conditions in the different tracts of India.

(vi) Trials in evolving varieties of cane which may be pest resistant, in co-operation with breeders.

Thus, the investigations relating to cane pests have to be carried out with due regard to all the different aspects of the subject; it may not be a wise policy to depend on one set of activities alone to get quick and satisfactory results. It is all very easy and convenient to remark glibly to an audience that the easiest way of fighting disease is by a change of variety and dispense with Entomologists and Mycologists, or to opine that Biological control is the only successful remedy against pests. But responsible workers all over the world, realising, as they do, the short-comings of such one sided activities in relation to the time factor, economy etc., appear to be of opinion that we cannot depend upon one or two factors alone and wait for the results, but

should explore all avenues of attack until we have found out the most suitable measure for each pest and region. Our main aim is to help the sugar planter as quickly and economically as possible.

Before concluding this short note the attention of entomologists and others interested in the sugar industry in India may be invited to the fact that, while we are engaged in devising ways and means to fight our local pests, we should not forget to provide ourselves with the proper precautions which will prevent the entry of the some of the serious sugarcane pests of other countries such as the sugarcane weevil [1] of Australia, the dreaded leaf hopper[2] of Hawaii, the frog hopper[3] of Trinidad, the cockchafer[4] of Mauritius or the widely distributed moth borer[5] of the West Indies—insects which have been causing very serious losses to the sugar industry in their respective countries. It is needless to add that in these days of rapid and convenient transportation facilities, animals and plants have very good chances of getting widely dispersed from place to place. I believe some of us are already aware of the fact that on two occasions the Imperial Entomologist, Pusa, while examining parcels of sugarcane setts received from abroad, came across the live grubs of the West Indian sugarcane weevil (*Sphenophorus sacchari*) in a parcel from Antigua and that of the Javanese beetle pest (*Holanaria picesens*) in a parcel from Java. It is incumbent on us, therefore, to see that two objectives are kept in view, viz., the control of the existing pests on the one hand and the prevention of exotic pests from entry. For, while we are engaged in solving our own insect problems connected with sugarcane, we should also be careful to see that no exotic pests of any kind get entry into the country and add to our already existing troubles.

NOTE ON THE CULTIVATION OF PINE APPLE ON THE LOWER PALNI HILLS

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The cultivation of pine apple, was first introduced on the lower Palni hills about 18 years ago by Mr. Bell, who was working as a coffee expert under Messrs. Stanes & Co., who then managed large estates both on Sirumalai and lower Palni hills. He introduced an Australian variety and it was propagated later on carefully by the Roman Catholic Missionaries in their estates on the hills. However, the crop was abandoned by them later on, owing to considerable damage done by

1. *Rhabdocnemus obscurus*, B.
2. *Perkinsiella saccharida*, P.
3. *Tomaspis saccharina*, D.
4. *Phytalus smithi*, A.
5. *Diatr.ea saccharalis*, F

wild pigs to it. With some difficulty an Indian Planter Mr. P. W. A. Marimuthu Nadar, managed to secure some plants through Mr. Bell in the year 1912—1913, and planted them in his bungalow compound on the hills. He gradually extended the cultivation. Finding this growing successfully he laid out a pine-apple plantation in the year 1920 and made known the availability of fruits by sending them to important markets. To-day there are 10 acres under this crop in his estate, compactly fenced all round by stone walls of 3 to 4 feet height to prevent the entry of wild pigs into this garden.

It is cultivated on the slopes of the hills at a height of nearly 3400 to 4000 feet above the sea level. The total rainfall in the region ranges from 60 to 65 inches per year. Except during the three or four hot months in the year, this portion of the hill has a fine climate. It is also cultivated in the midst of coffee estates where the tall silver oak trees provide them shade and thus in a way reduce the temperature even in the hottest part of the year.

The Soil. The nature of soil is gravelly on the upper portions of the slope with good black loam inter-mixed with organic matter. resting on a rocky bed below at a depth of one to two feet. The soil in the lower portion of the slope is a very rich loam mixed with small stones resting on a rocky stratum 3 to 4 feet below. Originally the whole region was under hill grass called Pothai growing to a height of four to five feet. This grass is generally used for thatching houses. The region under this grass is generally considered not suited for coffee, the soil being rather shallow. Hence this was taken up for Pine Apple growing.

Preparation of the Land. The hill grass was first burnt and then the stumps were lifted by mammutties and allowed to dry well during the summer. They were again burnt and the ash was well spread over the area. The whole area was then dug to a depth of one foot by mammutties. The stones obtained were as far as possible, usefully employed in building up the wall to form a protective fence. A portion of the stones thus collected, was used for terracing which protected the surface soil from erosion during heavy rains. There are three such terraces in a plot of 10 acres to a height of 1 to 1½ feet above the ground level. The clearing of grass jungle cost nearly Rs. 25/- per acre; while the digging of the land for the planting of suckers cost nearly Rs. 10/- per acre in the first year. The cost of removing the stones depends upon the nature of the land selected. However this particular, planter, has spent nearly Rs. 2500/- for removing the stones and utilising the material for constructing a stone wall along the boundary in a plot of 10 acres.

Selection of Suckers for Planting. Vegetative propagation is the general method adopted in the cultivation of this crop. The offshoots called suckers are removed from old plants for planting. The suckers

on the tops of the fruits as well as the whoral of suckers just at the bottom of the fruits are generally stunted in growth, with stout narrow serrated leaves. These suckers are generally avoided for planting, as they are slow growers taking nearly 2 years for bearing fruits. The suckers coming up from the underground portion of the stems are always long and slender with long narrow and smooth leaves. Even these are avoided for planting as they are far more slow growers, taking more than 2 years to bear fruits. But the suckers appearing at the axils of leaves just 2 or 3 axills below the top of the flower stalk are selected for propagation. These suckers are robust with thick long stems bearing broad and tapering leaves. Thus out of 4 types of suckers coming up from any old plant, only those arising at the axils are selected for propagation. These suckers come to bear fruit much earlier than the other type of suckers. However the period of fruiting even in these suckers depends upon their age from the period of their inception from the axils. It is generally observed that 6 months old suckers bear fruits in a year. Such suckers will be about 1½ ft. in height. The same character has been observed even in the case of plantains on the hills.

Planting. The whole area is marked both length wise and cross-wise by rope at 4' apart and small pegs are driven at each point of crossing of the ropes. Pits 1 × 1 × 1 are opened at the places of the pegs. The suckers are just planted in the pits and covered with loose soil. Thus about 1200 to 1300 suckers are required to plant an acre. The cost of opening pits after marking is Rs. 10/- per acre, while the charges for collecting and planting of suckers comes to nearly Rs. 3/- per acre. After planting no irrigation is given in the hills. The planting of suckers is generally done in Chitrai (April-May) on the hills when summer showers are usually received. It is during this period that the hill plantains are generally planted on the hills.

After Cultivation. During the first year, only one hoeing is given just after rains. But in the subsequent years the whole crop is hoed thrice in a year at the end of every fourth month, at a total cost of Rs. 15/- per acre per year. Each plant is earthed up during the time of hoeing.

Removing Suckers. Along with hoeing and particularly just after harvest of the fruits, the suckers except those at the top of the fruits as well as those at the axils of the stems, are invariably removed. This operation is done with a view to prevent the unnecessary wastage of nutrition from the mother plants. But it gives full opportunity for the proper and quick development for those suckers which would form the future mother plants.

Manuring. This crop has not been manured in the garden ever since it was started. The cost of manuring a crop on the hills is prohibitive owing to enormous cost of transport of the manure from the

plains. Under such circumstances the planters do not ordinarily manure other crops except coffee on the hills.

The Harvest. The formation and development of fruits, generally depend upon the age of the suckers as stated above and also on the fertility of the soil. As the soil on the slopes of hills varies in fertility and depth, all the plants do not come to bearing in the first year alone. A fair percentage of the plants bear fruits in the first year. The remaining plants bear fruits in the following December—January. Thus two yields are obtained from the crop in a year on the hills. However the heavier yield is obtained from the main season crop. Even from the season crop the maximum yield is obtained in the months of June—July. The harvest of fruits is regularly done at the interval of one week commencing from April and it is finished by the end of August. The proper maturity of a fruit is indicated by the development of external yellow colour from the bottom portion of the fruits. When the yellow colour spreads up to three-quarters, the fruits are harvested and sent to the plains for sale. Till they are disposed of either locally or in the market the fruits are arranged on the floor in rows with the top suckers. The cost of picking out the fruits from the fruit stalks and carrying them to the plains works out at the rate of Rs. 10/- per 1000 fruits.

Taste. The pine apple requires full 6 months for proper development and maturity from the period of its appearance, on the flower stalk. The seasonal changes during the long period of development have been found to cause marked changes in the taste of the furits. The prevailing of heavy dew on the hills before the summer crop of December - January, has something to do with the taste of the fruits. Thus the summer fruits always taste more sour than season fruits. The taste of the fruit depends also on the nature of soil. Pine apple growers' experience is that pine apple grown on the lands cleared of grass jungle is always more delecious than the fruits of the same variety grown in other parts. (i. e) after clearing the forest. The fruits grown on the grass regions, are found to possess a golden yellow colour when fruits are cut open whereas they look rather white in fruits procured elsewhere. (It may be worth mentioning in this connection that Mr. H. G. Stokes, the finance Member to the Government of Madras, after the lapse of long interval, recognised this variety from its golden yellow colour of the *perianth*.) Thus it seems clear that the golden yellow colour of the fruits always indicates the delicious taste of the fruits. However the constitution of the hill grass called 'Pothai' is not known. The salts left after burning the grass may have something to do with the taste of the fruits grown over this jungle cleared of this grass.

Keeping Quality. The fruits can keep, generally for a week. But the keeping quality of fruits can be increased upto 10 days, if the

suckers at the top of the fruit are not removed and the fruits are stored without overlapping. If the suckers are removed, the fruits can keep barely for a week.

Size of Fruits. The size of the fruits become smaller as the age of the garden advances. In this particular garden the fruits used to weigh 4 lb. to 5½ lb. till the garden was 7 or 8 years old. Thereafter the size of the fruits is gradually getting smaller in size. Now the original plantation is about 13 years old but still the fruits weigh upto 2½ lbs. It is worth mentioning, that this garden has not been manured all these thirteen years. On inspection, I find this now not in prosperous condition; it is high time that that garden is cleared and fresh area brought under this crop. Thus it may be stated that a garden of pine apple, under ordinary circumstances, can be continued with profit upto 12 years on the hills. The planter, has been advised however to apply the mixture of neem cake and fish manure to a portion of 2 acres, during the next season and to see how the bearing is.

Variety. The variety just grown on this hill, though resembles the well known 'KEW' variety, grown in the west coast, has different characters. Both resemble in one respect having smooth leaves with the top leaves incompletely serrated. But they differ in the following points (i) The kew variety is more robust and produces much longer leaves than this variety. (ii) The midrib region of the leaves is dark pink coloured in kew variety, while it is yellow coloured in this variety. (iii) The perianth of each fruit of the pine apple is surrounded with light pink colour even in the mature stage in the kew variety, while it is golden yellow in this particular variety. The same planter has recenty planted some 16 suckers of the kew variety obtained from Punalur on the west coast in a new garden of 2 acres devoted for this cultivation. They are just bearing fruits and one can very easily mark the kew variety from the other. Thus it seems that the variety originally cultivated by this planter is altogether a different one.

Marketting. This planter was it appears careful in removing the top suckers before the produce was sent for marketting. His idea was to reserve all material for extending the cultivation of this variety only in his estate. Thus he managed for 8 years and prevented the spreading of this variety both on this hills or anywhere else. Once he extended the plantation and brought the area to this desired extent, he did not mind sending the produce with suckers on. He has also been freely supplying suckers to others thereafter.

Besides supplying the markets of Madura and Tinnevelly, these fruits are transported to Kumbakonam, Tanjore and Madras in the north. These fruits are mainly transported to all the markets except Madras by a motor lorry kept for the purpose. The best fruits at his depot at Pattiveerampatty are sold at 0—6—0 each. Such fruits are generally purchased by European Officers of this District. The

medium size fruits are sold at 3 to 4 annas each. The lower grade are sold at 1 to 2 annas each,

Income. From the pine apple estate of 10 acres, the planter gets a gross income of Rs. 1000 per year, but his total charges for this estate including three hoeings removing suckers, and earthing up the plants, come to Rs. 300 per year. In addition cooly and supervision charge come to Rs. 400 per year. Thus he realises in normal years a net income of Rs. 300 per acre.

It seems that the planter has obtained a net income of even Rs. 400 per acre for nearly 12 years even when the damage by wild pigs was at its minimum. It was only then he advertised about the high qualities and delicious taste of the fruits in all the markets in the south. Recently the demand for the fruits has not been so keen as it was once before.

Wild pigs are regular enemies for this crop, The smell of these fruits attract a number of them during nights. Wild pigs not only damage the fruits but also uproot the plants to eat away the worms which are commonly found in the soil.

Notes & Comments.

Agricultural Meteorology. An important aspect of agricultural research which has recently attracted the attention of many works all over the world is Agricultural Meteorology. Very little attention appears to have been paid till now, at least in this country, to the study and the investigations on the various influences exerted by variations in the several weather factors like rainfall, temperature, humidity etc. on crop growth, crop returns, incidence of deseases and pests and the economic result in general. Workers in different aspects of agriculture are now beginning to realise, that changes in weather, in different areas, have a corresponding beneficial or evil effect on the crops, and studies on the ecology of plants and animals are now made in close relation to seasonal and whether changes. Forecasting of weather conditions even for such a short period as a week would be found very helpful to the agriculturist in some tracts. We would invite the attention of those interested in this subject to the three volumes of Bibliography on Agricultural Meteorology recently issued by the Ministry of Agriculture and Fisheries. Recently we also had a very interesting talk on this subject at the Agricultural College by Dr. L. A. Ramadass stationed in Poona as the Agricultural Meteorologist working under the Imperial Council of Agricultural Research.

Research on Pure and applied Sciences. Among certain Institutions and administrators there is at present a tendency to discourage all scientific research which does not show any immediate relation to

any practical needs of man, in fact an aversion for all pure or fundamental economy. It may be noted, as is well pointed in the leading article in Nature, of July 15th, that pure scientific research is not merely the gratification of intellectural curiosity but indeed an essential step in an economic process which results in applications to the practical issues of the day. What is wanted however, is, as beautifully explained in the article referred to, a judicious blending of both, and thorough co-ordination between workers in both lines. There should also be dominant in the minds of those who pursue the vocation of science, whether pure or applied, a spirit of service, and on the part of the public a generous recognition of that spirit in science and her followers.

The United States Department of Agriculture. It may be gathered from the following facts that economy cuts are in vogue in other countries and that the problem of unemployment is very much to the front.

It is reported that the personnel of the department of Agriculture in the U. S. A. and the funds for extension services, land grant colleges, vocational education, and experiment stations, have been considerably reduced by a 25% cut all through. More than a thousand persons have, it appears, been separated from the different bureaus of the agricultural department since March last and where vacancies had occured due to deaths or resignations, the places have been left unfilled. It is estimated that during the past year the total number of abolitions, dismissals and reductions in that one department amounted to over four thousand.

The Sugar Committee Meeting at Coimbatore. A meeting of the special committee by the Imperial Council of Agricultural Research, Delhi, to consider the future development of the Sugar Industry of India in its various aspects has been arranged to take place at the Imperial Sugarcane Station, at Chettipalayam near the Agricultural College, Coimbatore, during the middle of November. It is understood that very important schemes are to be discussed in connection with this important industry, and there is no doubt that all members of the Committee will always have the welfare of the Indian cane grower first and foremost in all their deliberations. We await with interest the results of the meeting.

ABSTRACTS

Weeds and their control. (*Department of Agri. in collaboration with the Univer. of Brit. Columbia Bull No. 106*). The subject has been treated in a popular language without the use of many Scientific terms. Although the publication presents information only about British Columbia, the introductory portion contains much useful information on (1) the organisation required to check spread of weeds, (2) the estimated losses from weeds (3) how weeds spread (4) how some of

them are noxious (5) the classification of weeds (6) the general methods of control and (7) the use of weed chemicals

Among the lines of assistance rendered by the Government in the matter of educating the farmers in overcoming this menace are (a) crop competitions and their value (b) seed fairs (c) propaganda through literature and (d) loaning of seed cleaning machinery.

The general methods of control include short rotations, use of high grade seed, grinding feed, ensilage, proper preservation of manure and the best time for weeding. The different cultural practices that are likely to keep down weeds are detailed under the annuals, biennials, winter annuals and perennials. Sodium chlorate at the rate of one o- two pounds in a gallon of water for 100 sq. ft. of weeds, is advocated for perennials. Copper sulphate (3% solution) at the rate of 75 gallons per acre when the grain crop is about 9" high, or sulphuric acid (3½% solution by volume) at the rate of 100 gallons per acre at the same stage is found effective on annuals like wild mustard (*Brassica arvensis* L.) in British Columbia.

R. B.

Carotin. *The principal natural yellow pigment of milk fat—Part II* (*Agrl. Exp. Stn. Missouri. Res. Bull 10*). Methods of identifying the two pigments carotin and xanthophylls in butter fat and plants, and their spectroscopic properties are described. All breeds of cows produce highly coloured milk fat for a short time after parturition, and the pigments are identical with the normal pigments of the fat. Such an increase is probably due to the different physiological conditions for milk secretion. The degree of colour production is to a certain extent dependent upon the kind of breed of the cows. The colour of cow's milk fat is due to the pigments carotin and xanthophylls which are usually associated with chlorophyll of all green plants. These two pigments are merely taken up by the cows from the greenfeed, and secreted in the milk When the supply through food is reduced or stopped, the butter fat becomes gradually colourless; the depletion of this colour is dependent upon the supply of the pigments, the length of time during which the supply is cut off, and the amount of milk fat secreted.

R. B.

The Digestibility of artificially dried grass. (*Vermont Agrl. Exp Stn. Bull. 348*). The object of the experiment is to find how far the concentrates may be replaced by the artificially dried grass, in the feeding of cows. Two sets of digestion trials are compared (1) green grass versus dried grass (2) dried grass versus grain in the entire ration composed of other roughages. The conclusions arrived at are (a) that in the matter of digestibility, both green and dried grass are equal, (b) that on the basis of dry matter both contain about the same digestible total nutrient matter, (c) that the digestibility of the various nutrients in dry grass and grain are different especially in crude fibre and ether extract and (d) that there is no difference in the mineral balances of calcium and phosphorous. R. B.

Potash on Potatoes. (*Tasmanian Journal of Agriculture Extension service staff*). Two replicated manurial trials were carried out with medium Brownwell potatoes, the plots being in randomised blocks with four replications. The treatments were, no potash, 2 cwts, 4 cwts, 6 cwts and 10 cwts potash sulphate. The results showed that potash had little effect except when applied very heavily and then it reduced the yield A small increase occurred in the case of 2 cwt. plot, but this was of doubtful significance.

Experiments on the comparative effects of sulphate and muriates of potash, showed that sulphate gave a greater increase in yield than muriates, but there seems to be no agreement in the two manures as to the best time to apply potash. There is a possibility that the effect of the dressings may extend over one season.

M. R. B.

Gleanings.

Twenty Tons of Sugar Per Acre. *Remarkable results in Queensland.* In the season of 1931-32 Brake, at the south Johnstone Station in Australia, carried out with sugar-cane, an experiment such as the International Institute has recommended be made, with sugar beets in as many regions as possible. Sugarcane of the Badila variety was planted on a deeply ploughed field, which was well fertilised and the soil kept at the optimum water content throughout the growing season. The crop was harvested at the end of 16 months and yielded 143·9 long tons of mill cane per acre (3612 metric quintals per hectare) containing 15·9 per cent of sucrose, corresponding to a yield of 22·8 long tons of commercial canesugar (94 per cent per acre, or 57·3 metric tons per hectare. The present average yield of sugar in Queensland, at best does not exceed 3 tons from unirrigated fields. (Facts from Sugar, June 1933.)

An effective formula for Poisoning Green Timber. An effective way for rapidly killing green timber and at the same time reducing suckering to a minimum is to frill the tree and poison it by pouring into the frilling a solution of sodium arsenite. The best time to carry out the operation is when the sap flow in the tree is ceasing, a period which varies in different districts, but as a rule commences about February.

A useful formula for quick and effective work in all kinds of timber is, arsenic 1 lb, washing soda 1 lb, or caustic soda ½ lb, water 3 gallons. Arsenic—the ordinary white arsenious oxide of commerce—is not soluble in water to any great extent, so that, soda, either the ordinary washing soda or caustic soda, has to be used to dissolve it. When large amounts of the solution are required, washing soda will be cheaper, but for small quantities of solution caustic soda will possibly be found the handiest.

When preparing the solution, whether caustic soda or washing soda is used, first dissolve the soda in a convenient amount of water, using heat if desirable, to hasten the process then slowly add the arsenic, which has been previously made into a thin paste, stirring all the time; place on a strong fire and after it has come to the boil allow it to remain boiling for at least half an hour, stir from time to time and be careful to stand on the side away from the fumes as they are poisonous and are apt to cause sickness. When the arsenic is thoroughly dissolved, the solution may be made up to the required bulk by adding the remainder of the water, either hot or cold.

Frilling the tree consists of a succession of downward axe cuts completely round the trunk, each cut well overlapping the adjoining ones so as to leave no unsevered section of bark up which the sap can flow. Frilling alone will ultimately kill the timber but the posion does it in a fraction of the time; in fact, trees have been killed in a few days. The cuts must be through the bark and well into the wood proper and as close down to the ground level as is convenient to cut them consistent with the shape of the tree - say, from 6 to 10 inches up. For trees of four feet in diameter, pour about a quart of solution into this frilling right round the tree, using an old tea pot or kettle, as the spout makes pouring easy, and less is wasted by spilling. Smaller trees naturally need less solution. Saplings may be cut off low down, and the solution dabbed on w th a swab stick to kill and prevent suckering.

It is very important that the frilling and the application of the poison be consistent and thoroughly carried out if good results are to be looked for.

There need be no fear of stock being poisoned by using the fallen or dead leaves from poisoned trees, for with the comparatively small quantity of solution used the likelihood of leaves absorbing any free arsenic is very remote;

but there is some danger, to stop grazing on areas frilled and poisoned, and it is desirable to keep all stock off for three or four days when all possible chance of danger would have disappeared.

Although arsenite of soda is obtainable from drug merchants, its use when procured in that form cannot be recommended for the poisoning of green timber, as it is most irregular in its arsenic contents. Prices for arsenic, caustic soda, and washing soda are apt to alter frequently. It is, therefore, advised that when a considerable area is to be treated one or other of the wholesale chemists be written to and quotations obtained.

Arsenic pentoxide may be substituted for arsenic and soda. It is soluble in water, but, as it has corrosive action, wooden or earthenware containers would be required.

Although the method described kills the tree much more speedily than frilling alone, the usual drying out must take place before the tree can be burnt. (Queensland Agricultural Journal.)

College News & Notes.

Michaelmas holidays. The College closed for Michaelmas holidays on the 15th September and reopened on the 2nd October. Consequent on the re-organisation of the University examinations by virtue of which there will be a University examination at the end of each year, the College Council has decided to do away with the terminal examinations in September. Consequently, there were no examinations before the recess for Michaelmas.

Games. *Y. M. C. A. Cricket tournament.* Since the first match of the tournament reported in the August issue of the Journal, our College played two more matches. The first was against the Municipal High School on the 26th August. We had first tenancy of the wicket and though we opened disastrously, we were able to put up a huge score of 200 for five wickets and declare. Narasinga Rao played a capital innings scoring 92, but was very unfortunate to miss the coveted century. Thomas followed with a useful 51 (not out). The School was dismissed for a total of 39 runs, Lakshmanan doing the most damage and following on, made 29 runs for 8 wickets. Our next match was against the New Mysore Sports Club. Batting first, the Club scored 122 runs, of which their captain Muthuswami made 36 and Ratnam 26. Lakshmanan was again successful with the ball, capturing 7 wickets for 53 runs, while Narasinga Rao took 3 for 39. Though we in our turn opened confidently, a series of disasters including two run outs and two l. b. w. decisions were in store for us, so that we finished up with a poor total of 90 runs. For the first time this season, our colours were lowered and an unbeaten record was spoiled by an unexpected defeat. Special mention has to be made of the fighting innings played by Albuquerque who scored 27 not out, and of Ramanatha Rao, who, despite the serious injury sustained earlier in the game, contributed a valuable score of 15. Our opponents in this match having won all their matches, the Rhondy Shield goes to them.

Games Tour. The first of our games tours this season came off during the third week of August when we went to Salem and played a series of matches in cricket, football, hockey and tennis. Advantage of the trip was taken to spend a day sight-seeing at Mettur, where the party was kindly shown round the dam works by Mr. Narasinga Kamath, assistant Engineer, who by the way is an old friend of the College having been in charge of the constructions of the Freeman Buildings. Our first game was at Cricket on August 20 against the Salem United Club. Batting first, our opponents made 129 runs. Narasinga Rao excelled himself with the ball taking as many as 8 wickets for 43 runs. We replied with 85 runs for 5

wickets when stumps were drawn. Ramanatha Rao made an unfinished 29. Albuquerque who retired hurt, made 18 and Shiva Rao 13. The same evening we met the Salem College at football and lost to them by 4 goals to 2. On the 21st, we played a cricket match against the Selam College and dismissed them for 70 runs of which the College captain made 40. Lakshmanan did best with the ball capturing 7 wickets for 27 runs. We replied with 85 runs for 5 wickets of which Thomas contributed 37 (retired) Narasinga Rao 16, and B. S. Murti 17 (not out). The same day we played hockey against the London Mission High School and won comfortably scoring 6 goals against 1. Though our best player was unable to accompany the party, a few matches in Tennis were arranged against the best local talents including some well known presidency players but our opponents proved superior to our men.

Football and Hockey. We played a friendly match each in Football and hockey against our sister institution—the Madras Forest College—and lost the former by 1 goal to nil. The Hockey match had to be left unfinished owing to rain when we were having a lead of two goals to one.

Ladies' Club. The Ladies' club building constructed recently was opened on the 8th September, by Mrs. T S. Krishnamoorthy Ayyar, the wife of the District Educational officer. There was a large and distinguished gathering of ladies and gentlemen in the Vadivambal Ammal Hall named after the wife of Rao Bahadur C. Tadulingam, when the guests were treated to music and *Pansupari*. On the 9th, the members of the Club entertained Rao Bahadur and Mrs. Tadulingam at tea in appreciation of the donation made by them and which made the construction of the building possible.

Research Engineer. It is learnt that Mr. N. G. Charley, B. E. till recently our Research Engineer, and who is now on leave in Australia, has been offered and has accepted the post of Research Engineer for another term of 5 years. Mr. Charley is expected to be back in Coimbatore by December.

Foreign Study. Three officers of the Department recently left for Europe for higher study. Mr. T. Murari B. S ., Superntendent of the Live Stock Research Station, Hosur, is now on a tour of several European countries undergoing further study in animal husbandry. Mr. J. A. Mulyil, B. A. of the Entomology section has proceeded to Great Britain for higher study in Entomology. Mr. C. Narasimhachari, B. A., M. Sc, has left for England for the study of soil Science and it is understood that he will do Research work at Rothamstead Experimental Station at Harpenden. It is learnt that Mr. P. V. Ramiah, Assitant Chemist will also be proceeding to England shortly. The best wishes of their fellow officers go to these gentlemen.

Visitors. Mr. P. V. Isaac, officiating Imperial Entomologist, Pusa, was at Coimbatore for about 20 days during September, studying the *Thysanids* of Coimbatore and the surrounding districts. Mr. R. D. Kapur, Economist to the Imperial Council of Agricultural Research was at Coimbatore on a short visit to study conditions of Agricultural economics and then left for Tennevelly. M. R. Ry. Rao Bahadur M. R. Ramaswamy Sivan, Retired Principal, Mr. M. R. V. Panikkar, Professor of Pathology at the Veterinary College, Madras, Mr. Pinto, Industrial Engineer, and Mr. D. S. Sahasrabudde, Government Agricultural chemist Bombay, attended a meeting of the Board of Examiners at the Agricultural College, on 12th October.

ASSOCIATION OF ECONOMIC BIOLOGISTS.

At an ordinary meeting of the association held on 4th September the following two papers were read and discussed:

Chromosome Numbers in the Genus Saccharum and its Hybrids. by T. S. N. Singh.

The paper which was illustrated with lantern slides, dealt with the chromosome numbers in the genus Saccharum, some of its interspecific and intergeneric hybrids, and four bud-sports that were noticed in the variety Co. 213. The various forms grouped under *S. Spontaneum* were reported to show chromosome numbers varying from 27 to 64 and the bud-sport numbers from 46 to 62, the one with 46 chromosomes being reported as a degenerate type. In the *Saccharum* hybrids, the doubling noted on the mother side by Dr. Bremer, was not noticed in certain of the hybrids with Indian canes. At the end of the paper, a discussion arose mainly on two points, one of which was, whether the author was able to distinguish the two parental genome sets in the hybrids. In this connection, it was pointed out that the study of somatic divisions as in root tips, which alone would throw light on such facts, was not undertaken by the author, owing to the large number of chromosomes in such divisions rendering the study difficult. The other point discussed was about the real nature of the degenerate type. It was suggested that apart from its losing vigour year after year, other conditions in meiosis, which the author had not studied, might reveal its real nature, there being no direct relationship between degeneracy and the smaller number of chromosomes observed in them.

Bees and Beekeeping in S. India. By T.V. Ramakrishna Ayyar anb S. Ramachandran.

The paper presented in a very compact form, an account of the honey bees we have in S. India of which there is no previous record and the popular methods practised all over India in artificial beekeeping. The paper also gave a short summary of the attempts that were being made by the Entomology section of the Agricultural Research Institute to demonstrate and popularise the modern methods of beekeeping as is practised in many of the western countries. At the end of the paper, was given a statement of the economics of beekeeping as a cottage industry in S. India, expenses involved and profits to be realised. A number of specially prepared latern slides were shown to illustrate the matter contained in the paper. At the end there was a lively discussion when questions were asked (1) about the importance and status of the wax moth, whether it was a real pest or only a scavenger as has been reported in the west, (2) about the obtaining of bees' wax used by the bee for building its hive without damage to the bee, (3) whether the eggs hatching out into workers were intrinsically different from those hatching out into queens, (4) what causes the bee to swarm and form separate colonies, (5) how does the male bee meet with its end, whether it is actually killed by the queen after the mating or does it die itself as a result of the removal of its coopulatory organs, (6) whether the honey collected by the bees during different seasons tastes differently etc. The authors in briefly replying to the various questions raised stated, that the wax moth was really a serious pest in S. India unlike in the west, that the combs become useless for storing honey after two or three years and might be destroyed to make the wax there from, that under favourable circumstances any worker egg can become a queen egg, that swarming and starting new colonies were essentially physiological intincts with the bees, when the hives become overcrowded, that the death of the male was not due only to the removal of the genital organs but to the removal of the whole entrails along with it, and that there were distinct differences in the taste and aroma of the honey collected in different seasons. With a few general remarks from the president the meeting terminated.

Review

"Agricultural Lessons" in Malayalam by *O. Raman Menon, Headmaster, Agricultural School, Tripunithora, Cochin State, (pp 265, Price Annas twelve).* This is an interesting and readable hand book in the Malayalam language on agricultural matters with special reference to conditions in the West Coast areas. The author has taken pains to systematise the different subjects and has treated the different aspects of agriculture in a clear and lucid manner. He has divided the subject into three main sections, that dealing with the soils including soil physics, agricultural engineering and agricultural chemistry, the second on botany including health and diseases of plants, and the third on the different cultivated crops and the various methods of raising each. This hand book is also supplemented with a few good text figures. There is no doubt that this small book will serve the needs of agricultural schools in the West Coast area. We congratulate the author on the excellent production and the nice get up of the book. (Editor, M. A J.)

Insects of Coconuts in Malaya by *G. H. Corbett—Bulletin No. 10. of the Department of Agriculture, Federated Malaya States.* This is a handy and well illustrated publication which may be found very useful especially to coconut planters in the Asiatic archipelago and to some extent to cultivators of this palm in Ceylon and S India. While it includes some general information on practically all insects noted on coconut in Malaya, special attention is found devoted to what appear to be the more important and well known pests of the palm. In order to make clear some of the inevitable technicalities in the text, the work is prefixed with a general note on insects and is followed by a useful glossary explaining the special technical terms applied in connection with insects. The illustration plates of which there are as many as 19, include two coloured ones which are nicely executed. This feature has considerably added to the value of the work since readers can identify insects much more easily from a good illustration than from lines of text. We congratulate the author on this useful work. (Ed.. M. A. J.)

Rice crop in Burma by *J, W. Grant, M.A., B.Sc., I. A. S. (Agricultural Department, Burma Agricultural Survey No. 17 of 1932. Price Rs. 3-8-0=Sh. 5. d 3.,* Rice is the most important crop in Burma covering about 75% of the cultivated area and it is on the rice crop that the prosperity of that country depends, as 75% of the population are engaged in rice cultivation and trade. The book gives a lucid account of the history, cultivation, marketing and improvement of rice in Burma. The main feature of the history of paddy cultivation in Burma is, that most of the area now occupied by rice has been brou ht under cultivation during the last 60 years by small cultivators producing for export market, the work having been financed by Madras Chettiars. Rice area is about 12½ million acres, and the production is about 7 million tons of rice, of which nearly 45% finds its way into the foreign export trade, due to the low density of population. Orginally before the war, Burma rice was occupying a predominant position in the European market as more than 40% of the exportable surplus found its way there. After the war, this export gradually declined less than 20%. due to the competition from higher grades of rices that have been produced by Spain, Italy and America. At the present time, India and Ceylon occupy an important position in the trade relations with Burma, as they consume more than 50% of the exportable surplus of Burma rice.

Most of the rice area in Burma is rainfed and the method of cultivation and rice growing is not in any way in advance compared with India, though the size of the average holding is considerably more in Burma being about 20 to 25 acres. Little or no manure is supplied and it can be said that the soils have reached the basic minimum fertility with continuous cropping for many years, without

adequate plant food not being returned to the soil. With the present prices of paddy, considerations of application of artificial fertilisers are out of question. Green manure crops are not in favour due to the conditions of soil after the harvest of paddy. The average yield is only about 1500 lb per acre and the cost of cultivation is about 15 rupees per acre and the net return is about 12 to 14 rupees per acre. Hence the importance of Burma's place in the international market is wholly due to the large exportable surplus which in turn is due to her sparseness of population. The organisation of marketing is mainly in the hands of big millers and middle-men who purchase the produce on the threshing floor.

As most of the rice is for export trade, improvement of the crop is directed towards the elimination of red rice and aims at uniformity, quality, and yield, in the selection of strains. The Department of Agriculture, Burma, have five research rice stations in the central tracts, where problems relating to rice improvement and selection of strains are tackled. In addition to these, there are about 122 seed farms established at convenient centres throughout the districts, for multiplication and distribution of improved seeds to the cultivators. Of these seed farms, 15 are equipped with buildings and storage facilities and in the rest, 107 in number, storage facilities are provided for, by the tenants who work on the land.—*N. P.*

Crop and Trade Reports.

Crop 1933-34 Gingelly First Report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1931-32, has represented 12·3 per cent of the total area under gingelly in India.

2. *Area.*—The area under gingelly up to the 25th July 1933 is estimated at 395,700 acres; compared with the area of 388,800 acres estimated for the corresponding period of last year, there has been an increase of about 2 per cent. Almost all the important districts except Anantapur, Chingleput and North Arcot have contributed to this increase, while these three excepted districts show a considerable decrease

3. *Yield.*—The yield is expected to be normal except in the districts of Chingleput, South Arcot, Chittoor, North Arcot and Salem, where the crop was partly affected by drought.

4. Details by districts are given below:—

Area in hundreds of acres, i. e., 00 being omitted.

District and Group.	Estimate of the area sown up to the end of		Increase (+) or decrease (−) of the area in column (3) as compred with the area in column (2).
	July 1932.	July 1933.	
(1)	(2)	(3)	(4)
	Acs.	Acs.	Acs.
Ganjam	25,0	29,0	+4,0
Vizagapatam	90,0	94,0	+4,0
East Godavari	47,0	48,0	+1,0
West Godavari	42,5	48,0	+5,5
Kistna	4,7	6,2	+1,5
Guntur	4	4	Nil
Total, Circars ...	209,6	225,6	+16,0

Kurnool	7	5	— 2
Bellary	4,8	2,9	— 2,8
Anantapur	12,0	5,3	— 6,7
Cuddapah	3	1	— 2
Total, Deccan ...	17,8	7,9	— 9,9
Nellore	8	3	— 5
Chingleput	24,5	11,0	—13.5
South Arcot	10,0	11,5	+ 1,5
Total, Carnatic ...	35,3	22,8	—12,5
Chittoor	3,5	3,6	+ 1
North Arcot	28,0	19.0	— 9.0
Salem	46,0	47,0	+ 1,0
Coimbatore	23,0	24,5	+ 1 5
Trichinopoly	3.6	4.0	+ 4
Total Central ...	104,1	98,1	— 6,0
Tanjore	1,8	7	— 1,1
Madura	8,0	10,5	+ 2,5
Ramnad	2,0	7,5	+ 5,5
Tinnevelly	9,2	21,5	+12,3
Total, South ...	21.0	40,2	+19,2
Malabar	1	2	+ 1
South Kanara	9	9	Nil
Total, West Coast ...	1,0	1,1	+ 1
Grant total ...	388,8	395,7	+ 6 9

Pepper Crop, Madras 1933-35—**First Report Area.**—The area under pepper up to the 25th August 1933, in the districts of Malabar and South Kanara is estimated at 95,000 Acs. (87,000 acres in Malabar and 8,000 acres in South Kanara) against 87,300 acres (80,000 acres in Malabar and 7,300 acres in South Kanara) as estimated on the corresponding date of last year.

2. **Condition.**—The setting in of the South-West monsoon early in the middle of May and the heavy rainfall afterwards were not favourable for the full flushing and flowering of pepper.

3. **Price.**—The whole-sale price of pepper at important markets on the West coast towards the close of August 1933 was about Rs. 19—10—0 per imperial maund of 82 and 2/7 lb.

Ginger Crop—Madras 1933-34—**First Report.** The area under ginger up to the 25th August 1933 in Malabar is estimated at 10,000 acres as in last year. The crop has been affected by root-rot disease in the Ernad taluk The condition of the crop is fair in the other taluks.

2. The wholesale price of dry ginger at Calicut towards the close of August was Rs. 7—2—0 per imperial maund of 82 and 2/7 lb.

Cotton Crop—Madras—1933-34—Second Report. The average of the areas under cotton in the Madras Presidency during the five years ending 1931—32 has represented 9 per cent of the total area under cotton in India.

2. The area under cotton up to the 25th September 1933, is estimated at 740,400 acres. When compared with the area of 822,300 acres estimated for the corresponding period of last year, it reveals a decrease of about ten per cent. The decrease is general and may be attributed to the fall in prices for cotton.

3, The area in the South and the Central districts relates partly to the last year's crop and partly to the current year's sowings which have just begun in parts.

4. The area in the districts of Bellary and Anantapur has fallen from 390,000 acres to 354,000 acres as sowings were held up by continuous downpours of rains.

5. The condition of the *mungari* or early sown crop in parts of the Deccan is satisfactory.

6. The wholesale price of cotton lint per imperial maund of 82 and 2/7 lb. as reported from important markets towards the close of September 1933 was about Rs 15—10—0 for Cocanadas, Rs. 14—0—0 for red northerns, Rs. 14—12—0 for white northerns, Rs. 13—9—0 for (early crop) westerns, Rs. 23—9—0 for cambodia, Rs. 22—2—0 for Coimbatore Karunganni, Rs. 20—11—0 for Tinnevelly Karunganni and Rs. 19—6—0 for nadam.

Sugarcane crop—Madras—1933-34—intermediate Report. The condition of the sugarcane crop is stisfactory owing to the good rains in August. Normal yield can be expected if the present conditions continue.

2. **Price.** The wholesale price of jaggery for imperial maund of 82 and 2/7 lb. towards the close of August was Rs 5—2—0 in Erode (Coimbatore). It ranged from Rs. 3—5—0 to 3—8—0 in Vizagapatam, Vellore (North Arcot) and Trichinopoly and Rs. 4—2—0 to 4—11—0 in the other important districts. As compared with the prices reported for July 1933, there was a fall of 15 per cent in Erode and 12½ per cent in Trichinopoly The variations in the other districts are small.

Weather Review (SEPTEMBER—1933)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	9·8	+2·5	36 5	South	Negapatam	2·7	−1·0	15·3
	Berhampore *	1 ·6	+2·3	45·9		Aduthurai *	2·8	−0·3	13·6
	Calingapatam	7·9	+0 3	34·1		Madura	1·4	+3·6	22·7
	Vizagapatam	5·5	−0·9	16 6		Pamban	1·0	+0·8	6·9
	Anakapalli *	11 0	+4·8	35·3		Koilpatti *	1·5	−0·6	10·7
	Samalkota *	8·5	+2·3	24 8		Palamkottah	1·1	+0·1	15·1
	Cocanada	7·6	−2·2	32·8					
	Maruteru *	6·3	+0·2	30·4					
	Masulipatam	4·9	+1·2	27·5	West	Trivandrum	9·2	+4·4	97·7
	Guntur *	1 8	−5·1	21·1	Coast	Cochin	14·5	+4·2	137·6
						Pattambi *	13 8	+5·3	121·9
Ceded	Kurnool	4·6	−1·4	18 6		Calicut	15·7	+7·6	149 8
Dists.	Nandyal *	3 5	−3·2	25·6		Taliparamba *	21·5	+10·8	171·8
	Hagari *	5·9	+3 5	21·8		Kasargode *	11·9	+3·0	150·5
	Bellary	7·7	+1·1	29·3		Nileshwar *	11·9	+0·1	153·6
	Cuddapah	2·5	−3·6	17·0		Mangalore	14·6	+4·5	144·9
	Anantapur	0·7	...	21·6					
Carnatic	Nellore	2 1	−2·6	17 4	Mysore	Chitaldrug	7·6	+2·2	27·1
	Madras	1 2	−3·6	9 0	and	Bangalore	4·1	+3·6	30·8
	Palakuppam *	3·9	−0·1	19 9	Coorg	Mysore	2·7	+2·7	30·2
	Palur *	1·4	−3·6	26·6		Mercara	24·4	+13·6	148·3
	Cuddalore	1·6	−4·6	22·2					
Central	Vellore	1·3	−5·7	14·6	Hills.	Kodaikanal	9·2	+0·9	51·7
	Salem	7·1	+0·7	29·3		Coonoor *			
	Coimbatore	6·0	+2·8	16 6		Kallar *	6·1	+2·5	38·7
	Coimbatore Res. Inst. *	5·0	+3·0	17·2		Ootacamund *	5·9	+1·4	48·1
	Trichinopoly	3·0	+1·6	18·8		Nanjanad *	6·2	+1·4	45·1
					Central	Hosur cattle farm *	4·1	+3·5	20·5

* Stations of the Agricultural Dept.

Summary of general weather conditions: The widespread thunderstorms which prevailed in the last week of August continued to be active till the 5th causing rain in South Madras, Mysore and Deccan. Then the conditions became unsettled in the central Bay of Bengal which developed into a depression on the 7th off the Circars coast moving northwestwards and was centred about 75 miles south east of Calingapatam. It crossed the coast near Calingapatam on the 10th into the interior and weakened considerably by 12th resulting in local heavy falls Another Bay depression formed off the Orissa coast on 12th passing into the inland strengthening the monsoon in East Rajaputana, Gujarat which later on weakened with heavy showers in Agra and Delhi. Simultaneously with the formation of a depression in the Bay, a shallow formed off the Konkan-Kathiawar coast, moving northwestwards and weakened causing an extension of the monsoon in Lower Sind. About the middle of the month a low pressure wave passed from the east into the Bay across Burma, moving westwards into the Bay and concentrated into a depression off the South Arakan coast. Consequent upon the intensification of the depression, a cyclonic storm was experienced at the head of the Bay on the 20th south east of Saugor island crossing into the interior as a deep depression over Chota Nagpur causing strong monsoon and heavy rains in Lower Burma, Pegu and Tennasserim. This gradually moved farther into the interior north westwards into Central Provinces and Central India and weakened itself with heavy showers in the Punjab and Kumaon hills on the 24th. Later on pressure distribution changed over to one of normal for the time of the year at the end of the month and conditions became favourable for the incidence of thunderstorms over the south. The monsoon showers weakened and withdrew from the country from about the 27th, with widespread thunderstorms throughout the Presidency.

The humidity was in excess in North Madras and Circars in the early half of the month and in defect in places elsewhere. For the major part of the month maximum temperature was below normal except in Nellore which recorded a maximum of 101° F about the 15th. The tendency was more towards returning to normal throughout the rest of the month.

Rainfall was in excess in parts of Circars, Ceded districts, the West Coast Mysore Plateau and South Madras.

The chief amounts recorded were Kodala (Ganjam) 5·9″ (13th), Hagari 2·8″ (3rd) Chitaldrug (Mysore) 3·5″ (4th) and Mangalore 2·7″ (7th).

Weather Report for the Research Institute Observatory: Report No 9/33.

Absolute maximum in shade	95·5°
Absolute minimum in shade	66·0°
Mean maximum in shade	87·2°
Mean minimum in shade	70·7°
Total rainfall	4·98″
Departure from normal	+ 3·00″
No. of rainy days	7
Heaviest fall in 24 hrs.	1·92″
Mean daily wind velocity	5·5 M.P.H.
Mean humidity at 8 hrs.	77·7%
Total hours of bright sunshine	202·7 hrs.
Mean daily hours of bright sunshine	6·3 hrs.

Summary of weather conditions: The pressure was steady throughout the month with slight fluctuations during the last week causing some showers. The rainfall was above normal but the temperature was generally above the average.

The weather was marked with local thunderstorms indicating a transition to the north east monsoon type of weather. The days were hot and nights sultry during the month.

C. V. R. and T. S. L.

Departmental Notifications.

First Circle. M. Ramamurthy, A. D. Palakonda, l. a. p. for two months from 24-10-1933; S. Ramaswami Ayyar, Botany Assistant, Anakapalle, l. a. p. for 15 days from 20-9-33. **Second Circle.** M. P. Narasimha Rao, A. D. Kaikalur, l. a. p. for 1 month and 20 days from 12th September 1933. **Third Circle.** P. Subrahmaniam, A. D. Gooty, l. a. p. on m. c. for one month from 23-9-1933 **Fourth Circle.** K. Varadachari, F. M. Palur extension of l. a. p for 10 days from 7—10—33; M. N. Rangaswami Ayyangar, A. A. D. Trivellore, transferred as A. F. M. Kalahasti. **Fifth Circle.** T. R. Venkaswami Rao, A. D. Tiruvalur, l. a. p for two months from 16—10—1933. **Sixth Circle.** G. Venkatakrishnan, on van duty, to relieve C S. Sankaranarayanan, A. D. Tirumangalam, posted to Tinnevelly; A. M. Muthayya Nattar, A. D. Dindigal, extension of l. a. p. for 10 days from 13—3—33. V. Ayyaswami Ayyar, A. A. D. Tenkasi, l. a. p. for 15 days; S. Bhimaraju, A. A. D. Sivakasi l. a. p. for two months from 6—10—33. **Principal's Section.** L. Narasimhachariar F. M. Central Farm l a. p. for 12 days from 9—10—1933; A. H. Subrahmania Sarma l. a. p. for 21 days from 14—9—1933. **Paddy Specialist's Section** R. Subbayya Gounder, Sub-Asst. l. a. p. for one week from 25—9—1933. **Millets Section.** P. V. Hariharan, Assistant, l. a. p. on M. C. for a month and a half from 25—8—1933; **Cotton Section.** P Abraham Asst. l. a. p. for 16 days from 22—9—1933. V. Marghabandu, Asst. l. a. p. for 11 days from 20—9—1933. **O. S. S's Section.** A. P. Balakrishnan Nair, F. M. Pilicode l. a. p. for 25 days from 11—9—1933. **D. A's Office, Madras.** L. Krishnan, Upper Subordinate, offg. to continue to officiate from 17—9—33 to 6—11—33, vice T. S. Venkatarama Ayyar A. D. on leave. T. K. Mukundan, Upper Subordinate, offg. to continue to officiate from 6—10—33 until further orders vice A. Gopalakrishna Ayya on other duty. **D. A's Office Orders** The following officiating appointments in the Madras Agricultural subordinate service—Class I Upper subordinates III grade in the scale of Rs. 75-7½/2-105 are ordered with effect from 20th October 1933. (i) M. R. Ry. N. G. Narayanan, B. c. Ag., to officiate as Assistant in the cotton section at Coimbatore *Vice* M. R. Ry. K. L. Ramakrishna Rao on other duty or until further orders—to report himself for duty to the Cotton Specialist, Coimbatore. (ii) M. R. Ry. C. K. Ramachandran, B. Sc. Ag, to officiate as Assistant in the cotton section *Vice* M. R. Ry. S. N. Venkataraman on leave or until further orders—to report himself for duty to the Cotton Specialist, Coimbatore. (iii) M. R. Ry. M L. Balasundaram B. Sc. Ag., to officiate as Assistant in the Paddy section at the Agricultural Research Station Maruteru *Vice* M. R. Ry. C. V. Saravayya Chetti on leave or until further orders—to report himself for duty to the Superintendent, Agricultural Research Station, Maruteru.

ADDITIONS TO THE LIBRARY DURING JULY 1933.

A. Books.

1. The New Agriculture. *O. M. Kile* (1932). 2. The Farm and the Nation. *E. J. Russell* (1933). 3. An Introduction to Tropical Soils (tr. by H. Greene). *P. Vageler* (1933). 4 Recent Development in Market Gardening. *Rothamsted Conference No. 15* (1932). 5. Satsuma Orange (a monograph). 6. Orchard Nursery Book: Budding and Graft ng (New South Wales Farmers' Bulletin No. 63). *T. Tanaka* (1932). 7. Orchard and Small Fruit Culture. 8. The Dairy Manual (New South Wales—Agri. Dept. Pubn.) *E. C. Auchter and H. B. Knapp* (1932) (1933). 9 Animal Industry in the British Empire. *A. N. Duckham* (1932). 10. The Scent of Flowers and Leaves: Its purpose and relation to Man. *F. A. Hampton* (1925). 11. Methods in Plant Histology. 5th Edn. Revd *C. J. Chamberlain* (1932). 12. The Human Eye and its inheritance (in German). Bibliographia Genetica—Vol. VII.

P. J. Waardenburg (1932). 13. The Genetics of Gossypium-Bibliographia Genetica —Vol IX *S. C. Harland* (1932). 14. The Commercial Timbers of India (in 2 Vols.) *R. S. Pearson and H. B. Brown* (1932). 15. A Bibliographical List of the Entire Domain of Agricultural Chemistry. 1. Soil Science. 16. 2. Soil Analysis. *H. Niklas and Others* (1931). 17. The Structure and Composition of Foods—Vol. 1—Cereals, Starch, Oil Seeds, Nuts, Oils and Forage Plants. *A. L. Winton and K. B. Winton* (1932) 18. Applied X-Rays—2nd Edn *G. L. Clark* (1932). 19 Laboratory Methods of Organic Chemistry—Revd. by H. M. Wieland; tr. by W. Mecartney from 22nd German Edn. *L. Gattermann* (1932). 20 On the Fixation of Atmospheric Nitrogen by Bacteria Living Symbiotically in Root Nodules of Casuarina Equisitifolia. (Oxford Forestry Memoirs No. 14). *R. N. Aldrich—Blake* (1932). 21. Principles of Fruit Preservation. *T. N. Morris* (1933). 22 Phytochemistry. *E. Kremers &c.* (1932). 23. Pigments of Flowering Plants. *N. A. Wakeman* (1913). 24. Vitamins: A Survey of Present Knowledge. *Eng. H. M. S. Pub.* (1932). 25. A Critical and Historical Study of the Pectic Substances of Plants. 26. Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists—3rd Edn. *M. H. Branfoot* (1933) (1930). 27. Principles and Practice of Agricultural Analysis: A Manual for the Study of Soils, Fertilizers and Agricultural Products—3rd Edn. Revd. and Enlarged:— Vol. I—Soils. *H. W. Wiley* (19 6). Vol II—Fertilizers and Insecticides. *A. O. A. C* (1931). 28. The Submerged Weir as a Measuring Device. *G. N. Cox.* (1928). 29. The Diaphragm Method for the Measurement of Water in open Channels of Uniform Cross Section. *C. R. Weidner* (1914). 30. Modern Farm Buildings. *D. N. Mc. Hardy* (1932). 31. The Beginner in Beeculture—3rd Edn. *W. A. Goodacre* (1931). 32 Better Life in the Village—(U. P. Govt. Pub.) *S. S. Nehru (Compiler)* (1933). 33. The Indian and the English Village. *F. L. Brayne* (1933). 34. Town and Country Side: Some aspects of Urban and Rural Developments. *T. Sharp* (1932). 35. The Economic Consequences of Power Production: 2nd Imp. *F. Henderson* (1932). 36. World Economic Survey—1931–32. *League of Nations Pub.* (1932). 37. Retailing and the Public. *L. E. Neal* (1933) 38. Inland Transport Costs. *F. P. Antia* (1932). 39 The Co-operative Movement in India. *E. M. Hough* (1932). 40. Monthly Rainfall of India for 1930. (1932). 41. Indian Year Book, 1933–1934. (1933).

B. Reports.

1 Report of the Food Investigation Board for the year 1931. 2. Annual Report (Twentieth Year) 1932: East Malling Research Station, East Malling, Kent—1st January 1932 to 31st December, 1932. 3 Transactions of the Highland and Agricultural Society of Scotland—Fifth Series—Vol. XLV—1933. 4. Annual Report—Tanganyika Territory—Department of Agriculture—1932. 5. Annual Report of the Statistics Branch—1932 of the Dept. of Agriculture. Part I—Agricultural Statistics. Part II—Chattel Mortgages. 6. Sixth Annual Report of the Council for Scientific and Industrial Research for the year ended 30th June 1932: The Parliament of the Commonwealth of Australia. 7. Official Year Book No. 25, *1932*. Commonwealth of Australia. 8. Fifty-fifth Report of the Connecticut Agricultural Experiment Station, New Haven for the year 1931. 9. Work and Progress of the Idaho Agricultural Experiment Station for the year ending December 31, 1931. (Bulletin 192 of Idaho Agri. Expt. Stn.) 10. Annual Report of Massachusetts Agri. Expt. Station for the year ending November 30, 1932. Bull. No 293. 11. The Teachers' College, Saidapet. Calendar for 1933–34.

C. Bulletins, Memoirs &c.

12. Orpiment in Shellac. *Ind. Lac. Res. Inst. Bull. 13.* 13. Interim Report on Work under Project No. 2. Strength Tests of Timbers in Structural Sizes with test Results up to 1932, *Ind. Forest Records, Economy Series, Timber Testing. Vol. XVII, Part VII.* 14. Immature Stages of India Coleoptera (12) (Carabidæ

Contd.) *Ind. Forest Record, Entomology Ser. Vol. XVII[XVIII.* 15. Studies on Sub-Soil Hydraulics. Investigation of Observational Methods for Models. *Punjab Irr. Res. Inst. Res. Pub. Vol. 2. No. 2.* 16. Sisal: A Note on the Attributes of the Fibre and their Industrial Significance. *E. M. B. 64.* 17. Fruit Supplies in 1932 (including vegetables, Flowers and Bulbs). *E. M. B. 65.* 18. Dairy Produce Supplies in 1932. (Including Poultry and Pig Products). *E. M. B. 66.* 19. Domestic Preservation of Fruit and Vegetables. 20. Narcissus Culture. 21. Commercial Bulb Production. *Eng. Mini. Agri. & Fish. Bull. Nos. 21, 44, 62* 22. The Nutritive Properties of Milk in Relation to Pasteurisation. *Hannah Dairy Res. Inst. Bull. No. 5.* 23. Plant Breeding in New South Wales. Fifth Year of Progress, 1930–31. *New S. Wales. Agri. Dep. Sci. Bul . No. 39.* 24. A Soil Survey of the Nyah, Tresco, Tresco West. Kangaroo Lake (Vic.) and Goodnight (N. S. W.) Settlements. *Australia Coun. for Sci. & Ind, Res. Bull. No. 73.* 25. Vegetable Growing in the Coast area of British Columbia. 26. Cooling Milk on the Farm. *Canada Dept. of Agri. Bull. Nos. 164, 165 New Ser.* 27. Farm Fencing. *Alabama Polytech. Inst, Ext. Ser. Cir. 136.* 28. A Preliminary Note on the Physiological and Genetic Aspects of Hair Properties in Egyptian Cottons. *Egypt. Mini, of Agri. Tech. & Sci. Service Bull. No. 123* 29. Cold Chlorosis of Sugarcane. 30. Sugarcane Root Disease in Cuba Zonate Foot Rot of Sugarcane. 31. The Sugar Industry of Peru. 32. The Tucuman Agricultural Experiment Station in its Relation to the Argentine Sugar Industry. 33. A Preliminary Report on a Grass-Root Mealybug affecting Sugarcane in Cuba. 34. The Cotton Industry of Peru. 35. Three Halminthosporium Diseases of Sugarcane. 36. Parasites of Sugarcane Moth Borers. 37. Pokkah-Bong and Twisted Top Disease of Sugarcane in Cuba. 38. Natural Enemies of the Sugarcane Moth Stalkborer in Cuba. Nematodes Parasitic on Diatreaea saccharalis Fabricius in Cuba Fungi Attacking Diatraea saccharalis Fabricius in Cuba. 39. Target Blotch of Sugarcane. *Cuba Trop. Plant Res. Found. Sci. Cont. Nos. 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17 & 18.* 40. Preliminary Report on a Study of the Biology of Lixophaga diatraeae (Tns.) 41. The Utilization of Varieties in the Field Control of Sugarcane Mosaic and Root Diseases in Cuba, (A Preliminary Report). *Trop. Plant. Res. Found. Sci. Cont. Nos. 19 & 20.* 42. The Sugarcane Moth Stalkborer. 43. A List of the Insects Affecting Sugarcane in Cuba. 44. Some Serious Sugarcane Diseases not known to Occur in Cuba. 45. Certain Grass Hosts of the Sugarcane Mosaic Diseases and of the Corn Aphid Considered in Relation to their Occurrence in Cuba. 46. Field Control of Sugarcane Root Disease Conditions. 47. Corn Stripe Disease in Cuba not Identical with Sugarcane Mosaic. 48 The Behaviour of the New Poj-Canes in Relation to Sugarcane Mosaic in Cuba. 49. Soil Insects Attacking Sugarcane in Cuba. *Trop. Plant Res. Found. Bull. Nos. 2, 3, 4, 5, 6, 7, 9 & 10.* 50. The Development of Package-Bee Colonies. 51. An Economic Study of the Pecan Industry. 52. Distinctive Effects of the Deficiency of Certain Essential Elements on the Growth of Tobacco Plants in Solution Cultures. 53. Causes of Brashness in Wood. 54. The Effect of Concentration on the Toxicity of Chemicals to Living Organisms 55. An Economic Study of Broomcorn Production. 56. Use of the Exponential Yield Curve in Fertilizer Experiments 57 Analysis of the Advanced Registry Records of 611 Daughters of 51 Ayrshire Sires. 58. Sudan Grass as Hay, Silage, and Pasture for Dairy Cattle. 59. Farmers' Response to Price in Hog Production and Marketing. 60. Bacterial Wilt of Corn. *U. S. A. Agri. Dept. Tech Bull Nos 309, 324, 340, 342, 346, 347, 348, 349, 352, 359 & 362.* 61. Roses for the Home. 62. Farm Sheep Raising for Beginners. 63. The Larger Corn Stalk-Borer. 64. Marketting Eggs. 65. Deciduous—Fruit Improvement through Tree-Performance Records. 66. Corncribs for the Corn Belt. *U. S. A. Farmers' Bull. Nos. 750, 840, 1025, 1378, 1696 & 1701.* 67. Commercial Feeding Stuffs. 68. Fertilizer Experiments with Cotton. 69. Creep-feeding Range Calves. 70. Alfalfa Production under Irrigation in Western Texas. 71. Sorghum Silage as a Source

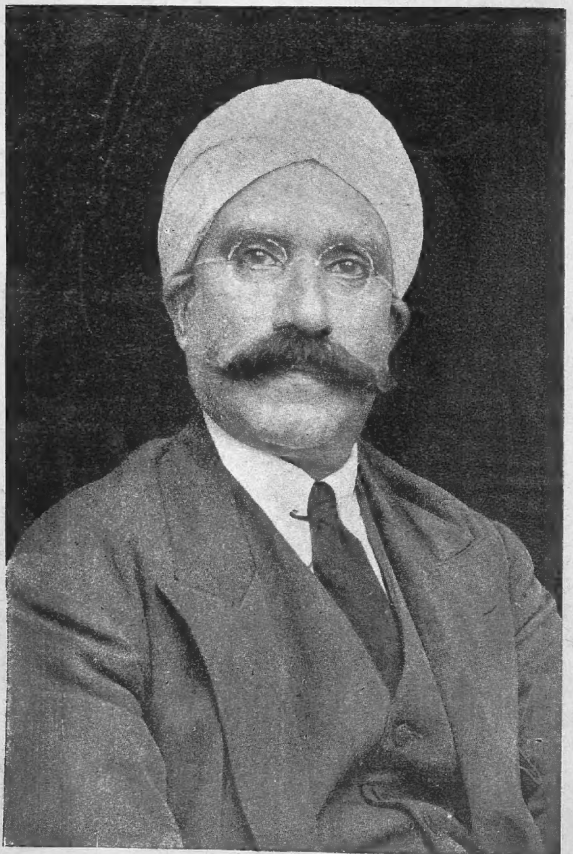
of Vitamin A for Dairy Cows *Texas Bull. Nos. 467, 469, 470, 472, 473,* 72. Studies on the Chemistry of Grape Juice. 73. Chromosome Number in the Genus Cucurbita. 74. Lysimeter Investigations: II—Composition of Rainwater at Geneva, N. Y. for a 10-year Period. 75. Percentage of Hardshell in Pea and Bean Varieties. *New York A. E. S. Tech. Bull. Nos. 181, 186, 193 & 195.* 76. Legume Inoculant Tests in 1931. 77. Dust Treatments of Cut Potato Seed. *New York A. E. S. Bull. Nos. 602 & 610.* 78. Recreational and Forestry Uses of Land in Massachusetts. *Massachusetts A. E. S. Bull. No. 294.* 79. Bearded Iris—A Perennial Suited to all Gardens. 80. The Planting and Care of Shrubs and Trees. 81. The Peony: A Flower for the Farmer. 82. The Gladiolus: Its History, Classification and Culture. *Cornell Univ. Extn. Bull. Nos. 172, 185, 220 & 231.* 83. Studies of the Genus Delphinium. *Cornell Univ. A. E. S. Bull No. 519.* 84. The Vegetative Propagation of Plants. 85. Some Effects of Freezing on the Physical and Nutritional Properties of Milk. *Maryland Univ. A. E. S. Bull. Nos. 335 & 344.* 86. The Dietary Requirements for Fertility and Lactation: the Specific Effect of Vitamin B on Lactation and Growth. *Arkansas A. E. S. Bull. No. 284.* 87. Parshall Flumes of Large Size. *Colorado A. E. S. Bull No. 386.* 88. Commercial Fertilizers, Report for 1931. The Mexican Bean Beetle. Microchemical Soil Tests. Potash Requirements of the Tobacco Crop. Tobacco Sub-station at Windsor, Report for 1931. Commercial Feeding Stuffs, Report for 1931. Report of the Director, Connecticut State Entomologist, Thirty-First Report, 1931. Chemical Investigations of the Tobacco Plant, Part III. The Food Value of Milk. Report on Food and Drug Products for 1931. Profile Characteristics of New England Forest Soils. *Connecticut A. E. S. Bull. Nos. 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341 & 342.*

D. Circulars, Leaflets &c.

89. Parasites and Parasitic Diseases of Horses. 90. Outlines of Cotton Culture in the San Joaquin Valley of California. 91. Mechanical Application of Fertilizers to Cotton in South Carolina, 1931. 92. Conserving Food Value, Flavour, and Attractiveness in Cooking Vegetables. 93. The Citrus Insects of Tropical Asia. *U. S. A. Agri. Dept. Cir Nos 148, 256, 264, 265 & 266.* 94. Pollination of Fruit Trees. 95. Beans for New York. *New York A. E. S. Cir. Revd. Nos.* 132 & 135. 96. Vegetable Storage, *New Hampshire Extn. Cir. 149.* 97. Septic Tanks for Farm Homes. *Massachusetts Extn. Leaf.* 143 93. The Grasslands of Australia and some of their Problems: Report upon the Dairy Pastures. *Australia Coun. for Sci. & Ind. Res. Pamphlet No.* 39. 99. The Marketing of Verum Cotton and Seed Distribution in Central Provinces and Berar. *Ind. Cent. Cott. Comm. Pub.* 100. Requirements of Tree Workers in Connecticut. Testing Vegetables for Connecticut Results for 1931 Lawn Seeding and Care. The Elm Leaf Beetle Outbreak. Quarantine Restrictions Affecting Shipments of Connecticut Plants 1932. Regulations Concerning Transportation of Nursery Stock in the United States and Canada. *Connecticut A. E. S. Cir. Nos. 81, 82, 83, 84, 85 & 86.*

E. Reprints, Mimeographed Publications &c.

101. The Intake of Tons by the Plant and its Relation to the Respiration of the Root. 102. Pythium Root Rot of Broad Beans in Victoria. 103. Ferns as House Plants. 104. Bulbs Indoors. 105. Window Plants. 106. Native Shrubs and Trees for Ornamental Planting 107. Concrete Tile Sub-Irrigation System. 108. The Institute for Plant Protection: Its Problems and Structure. (Leuin Academy of Agrl. Sciences in U. S. S. Q).



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